QRPp

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From the Editor

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The first thing that you will notice is that QRPp is a little bit different. Do you like the color scheme of the covers? That happened quite by accident. When I took the last issue to the printer, they did not have any of the yellow cover stock, so I chose green. I noticed that it was really easy to find my March issue, so I decided to have a "color" scheme for the various issues. March will be green for spring, June red for summer, September yellow for fall, and December blue for winter. Also, you will notice the quality of the printing is better. That is because QRPp is now being printed on a web press. Don't ask me to explain it, because I can't, but it is cheaper and better quality than Xerox once you get over 1000 copies. Note that we are now able to do photographs. Turn to the article on the Mr. Baldy Expedition, and you will see 2 pages of great pictures. Many of you have requested pictures, and now we have the capability. When you write those great articles, plan on sending along some pictures. Just make sure they are clear and have lots of contrast.

The next order of business is what is coming down the road. NorCal has a couple of projects that are in the pipeline. The Cascade was introduced at Dayton, and we mailed a brochure describing it to every member. It is the dual dual band ssb rig designed by John Liebenrood, K7RO. The transceiver puts out 8 watts on 75 and 5 watts on 20, or you can put a version on 40 and 17 meters. It is really exciting to operate QRP SSB, and I love my Cascade. The Icom 735 has been gathering dust since I got the Cascade built. The other project that we are gearing up for is the St. Louis Tuner. The St. Louis Tuner is a QRP tuner based on the Stocton Watt Meter and was developed by the St. Louis QRP group. We have made arrangements to offer it as a kit, and it will come in two flavors, in a NorCal 40 sized case, or in a Sierra sized case. It is a great tuner, and we will have more details in the next issue.

There are lots of good articles in this issue, and there are a couple of rigs that are for the beginner. We had kind of forgotten the beginners out there, so I made a special effort to find a couple of "beginner" type projects. Check out the Pixie 2 and the Key-7. Both of these rigs are offered as kits, and they are perfect for those of you who want to build your own boards. The Pixie 2 was the circuit that we used for the NorCal Build it at Dayton Contest. It was a lot of fun.

QRP to the Field was held the 1st of April, and we will have a full report in the next issue. I operated with Vern Wright, W6MMA, from his backyard in the foothills of the Sierras. We used the Epiphyte and the Cascade, and had a blast. It helps to have a 55 foot portable tower and a 5 element beam on 20 meters too!

Bob Finch, one of our members has come up with a great looking membership certificate. Details for that will also be in the next issue.

Finally, I have retired as Basketball Coach at Dos Palos High School. That should give me more time to devote to my favorite past time, QRP. I was amazed at how much time that I had this spring. I got to build a Cascade, work on a Pixie 2, go to Dayton, take my wife out for a couple of weekends, relax and have fun.

I have been working a nightly sked with several of the guys in Canada, and they have some more projects that they are working on. My rig has been QRP every night for the past month, and I have made it every single time! Who says you can't work with QRP! Hope that you have a great summer, and I will listen for you on the air. 72, Doug, KI6DS

Simple 160 Meter Antenna in a Restricted Space

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Most people don't think of 160 meters as a QRP band, but this really is a "qrp" article. Here is why: since the antenna is full-dimensioned, it must approach and intrude upon my neighbors. On 20 M and above, 100 watts to my vertical wire antennas definitely bother at least one of my neighbors. At five watts I have no problem. At 100 watts, my ground- mounted 80 M ground plane doesn't seem to bother anyone...maybe because of frequency, maybe because it is just far enough away from them. For the 160 M case, I must come close to the neighbors and I intend to keep my power down.

I live in a single-level duplex: my half of the "lot" is 90' x 60'. Of course, my side of the duplex occupies more than one-quarter of it. Fortunately, I have a cluster of fine tall pine trees...a factor in choosing to rent this particular apartment. Tall pine trees are fine for hanging vertical anetnnas. I have four wire antennas: all are "city verticals."

I like to experiment with antennas...and my living situation is such that I must experiment. A few years back, I picked up a 5,000 ft roll of #22 stranded, insulated wire for $5. Cheap wire in hand, I never hesitate to reel off whatever wire I need to try out antenna ideas. The wire is throw-away...no second thoughts.

Past reading of NEC modelling of a ground mounted ground-plane antenna indicated that for *short* radial lengths, five insulated above-ground radials were no less efficient than a large number of radials. Peak radiative efficiency occurred in the vicinity of 1/8 wavelength radials—then fell at greater lengths if the number of radial was five, or twenty. If there are 120 radials, efficiency continues to rise as the length of the radials increases. This does not mean that short radials are efficient relative to a horizontal dipole 1/2-wavelength
above ground. It does mean that under the contraint of *short* radials, 120, 20 and 5 radial-antennas are comparable. Understanding this breaks past a psychological barrier that might inhibit one from even trying!

Since I already have a 80 M antenna of the intended type, I know that a 66 foot vertical wire, looped over at the top giving an apparent resonance around 3.8 MHz in conjunction with six radials of 32 ft. Therefore, I began by reeling off 132 feet of the #22 for the vertical portion and four pieces of 66 feet for the radials.

I lanyarded the 132' wire up the tree, over the top and down again. I attached one end of the wire to a line which I shot over the limb of a close-by pine and hauled it up. This gave me an approximately 75 foot vertical portion with the remaining ~60 feet bent over and gently, crookedly sloping downward about 40 feet in a South-SouthWestly direction.

Why four radials? Because of physical restraints. The pine with the vertical wire is on the property line (east-west). I stretched one wire west and staked it at the edge of the back access road. I stretched another wire eastward, covering it with pine straw and burying it where it runs near and under the back entrance path of my neighbor in the other half of the duplex, crooked it, ran it around the edge of the house foundation. We both rent...and mylandlady likes me. The third radial runs slightly east of south on top of the pine straw, into the crawl space of the apartment and is staked against the far foundation wall. The fourth radial runs more-or-less SouthWest, hops a low curbing at the corner of the house and is staked finally in what passes for my day lily flower bed. I can not run radials northward at all.

This is not a balanced radial net relative to the vertical element...but the fact that that vertical element "leans" over to form a "hat" over the radial field may help things.

I soldered the vertical wire to the center receptical of a female coax fitting. I pigtailled the four radials together and soldered them to the "plate" of the coax fitting. I tethered the coax fitting two feet above ground and one foot from the trunk of the pine tree.

Using my MFJ Antenna Analyzer, I found the SWR was still dropping as I tuned below 1.8 MHz. I removed some wire from vertical wire... until the SWR "dipped" at 1.860 MHz (1:1.2+ was lowest value, which is a combination of radiation resistance plus ground losses). Based on past experience, this is the result I expected.

I soldered coax plugs onto a spare 57 ft piece of RG-59 (75 ohm) coax...and re-checked SWR curve. It was never below 1:2 and the "dip" was out-of-band.

I inserted my old, cheapy MFJ transmatch between the coax and the Antenna Analyser. Setting the Analyser to 1.850 MHz, I tuned for lowest SWR (are you following this?). Because this is 160 M, the tap position is the last one...putting the whole inductor into the circuit. It's not quite the right value...resulting in not getting a match lower than 1:1.6 anywhere in the 160 M band.

Then I insert Transmatch *between* antenna feedpoint and coax feed line. The Antenna Analyser was still positioned at end of coax, where the transmitter would be *without* the transmatch (Are you following this?). Setting the Analyser to 1.850 MHz, I adjusted the transmatch: the SWR drops to 1:1...giving a 1:1.2 SWR-bandwidth of over 20 KHz.

Detaching the Analyser, I stretched the coax to my car 40 feet away. I hooked it to my cross-needles SWR meter which in turn is hooked to my Kenwood TS-430-S (remember, the transmatch is *at* the antenna feed point, not at the transmitter!). Sweeping band at low power, it appeared I've got at least 30 KHz bandwidth of operation before I'd need to readjust the transmatch at the antenna.

That describes my main antenna used for the QRP SSB Fox Hunt on Tuesday, 28 Feb. Though I used this city-lot antenna for the Hunt, I could have used my mobile antenna—a loaded 18-ft mast on my 1979 Ford LTD. I asked several stations to give me a comparison reading between them as I switched back and forth. The mobile mast was one or two S-units weaker...but copyable to all, even the Michigan QRO station that called me.

160 M is worth a QRP effort. Night time skip appears to be excellent. Don't hinder yourself by thinking that you must litterally own a couple of acres to put up an antenna for this band. Nothing could be farther from the truth. 73/Steve/AB4EL ab4el@Cybernetics.NET in Raleigh, NC 35.81245N, 78.65849W

Advice to a Beginner

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Glad to meet you. I remember back in 79 when I was 23 years old. I had no money for ham gear. The license was free though. All I had to do was study (ARRL Handbook 76) and practice code (on borrowed tapes). I had my Extra in less than 2 years after 4 trips to the FCC in Baltimore. I figured the money would be there later. Then I would buy a rig.

There are a lot of good kits out there. Get one that comes in pc board form less pots, case, knobs, etc. You can save a bundle by scrounging around for those parts.

Do you have a balcony or metal rail? Clamp on a Hamstick. They sell for about 18 bucks and work. I use one on the roof (metal) of my mobile home. We are not allowed antennas there either. I find that challenging too.

My elmer loaned me a Gonset communicator II (2 meter AM). I converted it to FM transmit and used slope detection for receive. I had to buy a $10 crystal. Made my first contact on the local repeater with it!

I had a Heathkit HT for 2m. My first HT. It was a piece of trash. But, I eventually got decent rigs for HF and VHF. Took about 10 years. My point is that I now get more satisfaction out of doing more with less. Whether that be in terms of power or money, it does not matter. If I built it, then I enjoy it even more. My goal is not to have all the best commercial equipment. It is to have built everything I use. This is even going to include VHF SSB gear. (QRP of course). HF is the best place to start. Build a DC or superhet receiver or a crystal transmitter. Try going portable. Find a school yard with trees and throw up a dipole. The point is to get some experience, it is the best teacher by far.

One thing about the QRP hams....they are some of the best encouragers I've met. We'll all cheer you on. 72 de Cameron, KT3A

QRP ARCI Awards Summary

by Chuck Adams, K5FO

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1,000 Mile/Watt Summaries by Band

BAND	TOTAL	GREATEST VALUE	CALL
1.8 MHz	10	13,300 Mi/Watt	GW4AEC
3.5 MHz	42	851,339 Mi/Watt	AA2U
7.0 MHz	195	1,909,502 Mi/Watt	AA4XX
10.1 MHz	15	20,727 Mi/Watt	NW0O
14.0 MHz	380	87,800,000 Mi/Watt	OK1DKW
18.0 MHz	3	59,380 Mi/Watt	K4TWJ
21.0 MHz	445	19,250,000 Mi/Watt	WB6UNH
24.0 MHz	4	2,445 Mi/Watt	JL1FXW
28.0 MHz	207	218,333,333 Mi/Watt	K7IRK
50.0 MHz	56	134,200,000 Mi/Watt	JO1XWH
144 MHz	13	87,800,000 Mi/Watt	OK1DKW
220 MHz	2		
432 MHz	5		
1296 MHz	6		
10 GHz	2		

CW	1043
SSB	296
AM	47
FM	7
RTTY	4

other 15 (some unknown)	
WAC	526 awards total
DXCC	124 awards total
WAS	352 awards total
QRP-25	1041 awards
QRP-50	559 awards
QRP-100	342 awards
QRP-200	121 awards
QRP-300	52 awards
QRP-400	26 awards
QRP-500	18 awards
QRP-600	11 awards
QRP-700	8 awards
QRP-800	4 awards
QRP-900	2 awards
QRP-1000	2 awards
QRP-1100	1 award

NOTE: N5DUQ gets the first 5-Band WAS SSB QRP ever. 72, Chuck Adams, K5FO, ARCI Awards Manager

Atomic Bomb Anniversary Special Event Station

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The local (Socorro, NM) ham club received official permission Tuesday from White Sands Proving Grounds for us to operate a special event station from "ground zero" at the Trinity Site on the 50th anniversary of the first atomic detonation. They imposed a fairly narrow window on us for operating, namely 0500-noon local time on Sunday, July 16, 1995. Therefore, in addition to the QRO stuff, we will try to keep two QRP stations on the air to makeup for this short window. Also, we will be operating the day before as well, Saturday and later that Sunday afternoon, from somewhere.

We're trying to get permission to work out of one of the old barracks buildings used during the test, now located on private land. Details of the Saturday and Sunday afternoon/evening operation will be issued later. However, the Sunday operation is officialized, and I'm including the official "politically correct" White Sands approved press release. This is the version to appear in QST, etc. (We are verbotten from using the word "celebration.")

By the way, you'll notice whose call they voted on to use at last nights ham meeting. And I wasn't even there!
—Paul NA5N

White Sands Press release:

Amateur Radio Operators Will Observe the Fiftieth Anniversary of First Atomic Bomb Test

The 50th anniversary of the world's first atomic bomb test will be marked by an amateur radio special event station operating from near Ground Zero — Trinity Site — in

the Central New Mexico desert.

The Socorro Amateur Radio Association (SARA) will operate NA5N from 1100-1700 UTC on Sunday, 16 July 1995, and will use the General phone and CW portions of the 80, 40, 20, 15 and 10-meter bands, depending on propagation. On the CW bands, a war-veteran straight key from the Pacific Theater of World War II will return to the air for this event.

Just before dawn on 16 July 1945, the Manhattan Project successfully tested the first atomic bomb at Trinity Site, about 36 miles southeast of Socorro, New Mexico. Trinity Site, now a part of the U.S. Army's White Sands Missile Range, normally is opened to the public only twice a year, in April and October. The Army is opening the site for visitors on the morning of 16 July for the 50th anniversary, and has granted permission for SARA to operate the special event station then.

The station will operate only during the six-hour period 1100-1700 UTC. Because of missile range requirements, the transceivers at Trinity Site will be limited to 50 watts output power. In addition, a QRP station will be operating on the QRP frequencies of 7.040, 14.060, 21.060 and 28.060 MHz, again depending on propagation.

For a QSL/Certificate, amateurs contacting the Trinity Site Special Event Station should send QSL and business-sized, self-addressed, stamped envelope to the Socorro Amateur Radio Association, Trinity Site Event, P.O. Box 522, Socorro, NM 87801.

Trinity Site will be open to the public the morning of 16 July. The White Sands Missile Range Stallion Gate will be open to visitors from 5 a.m. to 11 a.m., MDT. Stallion Gate, east of San Antonio, NM, (on US 380) will be the only gate open to the public for this event. On 15 July, the National Radio Astronomy Observatory will offer guided tours of the Very Large Array radio telescope west of Socorro. For information about accommodations and other events in the area, contact the Socorro County Chamber of Commerce, P.O. Box 743, Socorro, NM, or call (505) 835-0424.

Replicating the Epiphyte: Reproduction with Compromise

by Grant Hannan, VE7PTW
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The pleasures that make amateur radio such a fulfilling endeavor are not the same for every amateur licensee. For one it may be the thrill of chasing a rare DX station. For another it may be the coordination of a local traffic net. And yet, for someone else it may be blasting out the strongest signal on any band. The satisfactions of ham radio are as varied as the hobby itself.

My earliest recollection of the thrill of radio was way back in the late fifties when my soon to be brother-in-law brought a crystal detector in the package of a rocket to our home. This Rocket Radio captured my attention as the sound of a distant AM broadcast station filled the tiny earphone. How could something so small offer such pleasing results?

Several years later I once again discovered the excitement of using less to accomplish more when my high school electronics class built one-tube transmitters and thereby pounded out CW to an unsuspecting world. Does anyone recall the venerable 6L6?

The summer of 1994 brought our family to beautiful British columbia from the prairie land of Saskatchewan. Any previous exposure to QRP in VE5 land was, of course, in the form of morse code. By late summer I had learned, though, that an active group of West Coast hams enthusiastically pursued the design and construction of single sideband

QRP transceivers. Subsequently, an invitation was made to attend a meeting of this illustrious body to be held right here in Nanaimo in September.

It was at this meeting that I first was made aware of the Epiphyte and the other SSB transceivers conceived and born in BC. It was also the first time that I was able to meet those who now have become household names to me. VE7QK exhibited a completed circuit board for the Epiphyte. The careful attention to layout and ease of construction could not go unnoticed. Although I had not yet heard the Epiphyte, the decision was made to try to replicate one of those little radios.

As was suggested by Derry, VE7QK, the circuit board was ordered from FAR Circuits of Illinois. By this time two more local hams had decided to build the Epiphyte. Various delays resulted in the boards arriving in mid-November. Availability was not the problem. Apparently the postal system may have caused the delay.

Once the boards were received, many of the components were purchased locally and on the lower Mainland. A couple of evenings labor resulted in most of the parts being soldered to the board. The article submitted by Derry which appeared in the September 1994 issue of QRPp "The Epiphyte, A Simple SSB Transceiver" pp. 29-37, was invaluable to the construction of the circuit board. By closely following the schematic and the parts layout, all components fit neatly in their respective places. Enlarging a photocopy of the top side of the board also helped to determine what went where. The traces on the bottom side of the board are readily copied through the board material. This provided a top of board view with all the traces clearly visible.

Most amateur radio enthusiasts could work wonders if only they had the time to devote to their passion. However, distractions do occur which divert one's attention from the task. For me, the Epiphyte project had to be put on hold for a time while I dealt with the consequences of a break and enter at my home QTH near the end of November. Among the items stolen was my Standard Twin Band handheld. The replacement unit which arrived inJanuary played a vital role in putting the Epiphyte on the air.

Along with the theft of many of our prized possessions came another period of time where the Epiphyte had to be put aside to await another day. By now it was December and the holiday season was upon us.

The last few remaining parts to obtain were the ceramic resonators, the Murata filter, and the Toko coils. Working together with Rod, VE7ESA, the 4.19 MHz resonators arrived from a supplier in the UK. A short time later the remainder of the needed components arrived via parcel post. These were hastily soldered into place. The chassis and case had been prepared ahead of time, making use of the time while waiting for parts to arrive.

Tune up and alignment were accomplished in compliance with VE7QK's article. The exception was that I used my Standard handheld's capability to produce a single frequency tone of 1209 hertz. Duplicating this tone by that produced from the crystal calibrator of my Yaesu HF rig gave me a constant, QRM free audio tone which was injected directly to the self-contained electret microphone. The end product was an easy alignment of the the RF filters and output consistent with predicted results. The project was complete, or almost.

The Epiphyte succeeded in surpassing all expectations. Reports while operating barefoot were pleasing, if not flattering. I was able to check into the British Columbia Public Service Net on 3729 kHz. with no comment made as to the little rig sounding good or bad. As far as I am concerned this speaks volumes for this radio. But a little extra punch would be desirable and the decision to add a 5 watt amplifier was made.

The circuit board for the amplifier was locally produced by Harry, VE7BUY. Harry is also constructing an Epiphyte. He should be on the air by the time this issue is pub-

lished. [Note: He is, as I made contact with him on the VE7 SSB QRP net on March 27, 1995. KI6DS, Editor]. The circuit board and the components went together in one evening. In my case I decided to run the amplifier outboard to allow for flexibility in future usage. An external dynamic microphone was the final additon to this date, although a frequency display is not too far off. On air reports with our friends of the NorCal group and with many VE hams, both local and distant, have been better than complimentary. The Epiphyte performs like a big rig; better, if one considers the invested cost per qso.

VE7QK's article states that one of the objectives in designing the Epiphyte was to produce a transceiver that was easy to replicate. That objective has been met with certainty. Furthermore, Derry noted that a radio of this simplicity cannot be achieved without compromise. Obviously this is true, but building the Epiphyte does not mean one needs to compromise performance. On the contrary, the Epiphyte offers ease of reproduction in a way that just may redefine compromise. If one follows recognized assembly procedures, the "plant growing on another", will yield "**COM**munication **PROMISE**". If all the parts were on hand when the project began, this transceiver could have been on the air in less than one week, start to finish. Even though this Epiphyte took more time, the degree of satisfaction has not been diminished.

I would be remiss if I did not extend my thanks to Derry, VE7QK, for his efforts surrrounding the Epiphyte. Also to the members of the QRP Club of BC for their many reports on signal quality and strength. And those of the NorCal group who are more than willing to encourage all others who wish to experience the pleasure, the thrill, and the excitement of **QRP: DOING MORE WITH LESS TO REPRODUCE THE PROMISE!**

72, Grant, VE7PTW

Requiem for a Fox Hunt

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Just a note on the late, great first-ever qrp hf cw fox hunt. I've been asked what kind of antenna, etc., I used while pursuing Mr. Fox. The answer is ... nothing spectacular. All contacts were made with an HW-8 (1 watt on my homebrew meter) for a transmitter and most were made with a Yaesu FRG-100 for a receiver. Antenna is a dipole up about 25 ft situated north-south. That's it - but in the works are a transmatch/G5RV and a dsp filter (and, oh yeah, a xcvr from Small Wonder). I guess that I'm already thinking about the next foxhunt!!!

I don't know how to properly thank Chuck , K5FO, for the concept, prizes, etc., nor the foxes for their sometimes heroic efforts at digging weak ones out of the noise, so I'll just leave it at that. Thank you.

The foxhunt was interesting, entertaining, rewarding, educational, and at times frustrating, and at other times, very frustrating - but it was alway fun. However, unlike some other contests, the foxhunt wasn't without a purpose - it got some of us to dust off our keys and do a little qrp operating. I think it fulfilled its purpose very well.

73s, Glen K5UP

Maryland Radio Center QRP Show and Tell

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Another good QRP Show and Tell at Maryland Radio Center in Laurel, MD! We had our usual 2 dozen-plus people, lots of familiar faces and calls, some new ones seen in person for the first time, some merely-curious non-QRPers, etc.

K3TKS, Danny	KD3S, Jim	N3GZT, Mark	WA2UNN, Clark
N3LRX, Randy	KC3MX, Harry	N3MIT, Pat	NF3I, Scott
W6TOY, Bruce	WA5JAY, Hal	N3CDR, Herb	KD3IO, Bob
K2EB, Bob	KO4A, John	N3AFN, Walt	KT3A, Cameron
N3JBU, Ken	WA4DWD, Bob	WA8MCQ, Mike	WA4KAC, Walt
KA3ZOW, Dick	AF4K, Brian	WO3B, Bob	WB3V, Bill
W4NFR, Bill	K3OAH, Allen		

K3TKS brought along his QRP Plus to show off and ran coax to the MRC antenna patch panel so we could check it out properly. Neat rig! W4NFR also brought one along; he's a salesman for the QRP Plus, showing it off at hamfests and taking orders for Index Labs. K3TKS also brought along his usual collection of Kent keys and paddles.

WA5JAY showed off his tiny 40M CW XCVR-in-a-pill-bottle, one of the DB-25 series of rigs, and I had both WG3R's 40M CW XCVR-in-a-pill-bottle as well as my own transmitter; this is the first time in several years that there have been more than two DB-25 rigs in the same room at once. I also showed off the package to be used for Phase II of the DB-25 challenge (see the March 95 issue of QRPp); no one has done any soldering yet, but at least I have an SMA jack mounted on the fuse box, earning me the honor of First Blood.

WA5JAY also showed off his 3 X 3 X 3/4 20M SSB XCVR, built circa 1990. KT3A brought a NorCal Sierra, the first one I've seen in the flesh, and it was impressive! KA3ZOW, of S&S Engineering, had his new TAC-1 knob-tuned synthesized rig, and says he expects to ship very soon—the cabinets should be in this week and that's all he's waiting on. There were also various NorCal 40/40As, NE3040/4040s, etc. Not as many QRP rigs as we usually have, but still a good variety and lots of good QRP stories being slung around right and left.

We'll probably do one of these again in a few months; stay tuned for the announcement! 73 and Queue Our Pea DE WA8MCQ

A Unique Way to Install the MRF237 in the NC40A

by Stephen Shearer, WB3LGC
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I knew there was a reason I havn't rushed to get my NC40A up and running with modifications from the past QRPp journals (I do need to find space in the shack to work, first).

I am planning to add a MRF237 to my rig (as I build it) and want to pass on my comments/thoughts for doing the modification, as I have not heard of anyone else doing it the way I plan (I never did like to follow the crowd). Since the MRF237 has a reversed

C/E lead compared to the 2N3553, longer leads and insulation/shrink tubing is needed to mount on "normal" side of the circuit board (or emitter path through a grounded heatsink and questionable inductance).

My plan is to use the 0.375" space under the circuit board for mounting a heatsink (customized) to the bottom case for good heat transfer of all the POWER. The MRF237 is 0.180" high and with 0.030 to 0.060 space between the transistor and the board (I plan on a teflon(tm) spacer, as I think I can find a few scraps here at work) — leaving ~ 0.125" free space. The heat sink is going to be a 0.5" round brass with a 5/16" hole in the middle. One end I will drill/tap two (4-40) mounting holes. The other end, I will turn down to ~7/16" and saw slots for the fingers to grab the transistor. Mount the heatsink to the lower case (careful measurments required - use the standoff hole as a reference), install the transistor in the heatsink with leads in alignment to the holes in the circuit board.
NOTE TO BEST PART: the C/E leads are now going into the correct hole, WITHOUT crossing and without a grounded heatsink/emitter lead path. A standard heatsink, like the one supplied, may work just fine — with limited air flow, I want the case to be part of the heatsink. 72/73, Steve WB3LGC

NorCal 40A Measurements

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My 40a was completed about 10 days ago, and a birth announcement was sent to qrp-l. In that note, I mentioned that the output was trash for low power settings. Last week I had a few minutes to look at the rig on the spectrum analyzer. It was stable and clean into 50 ohms, and there was no indication of instability that I could recognize. The instability occurs when the rig is terminated by my antenna/tuner. Output is fine from maximum power down to 1 W and then it is garbage down to 0.25 W. The results of my lab measurements follow.

NorCal 40a Spectrum Analyzer Test Results from 3/2/95

First test: look at output for recommended supply voltage with power set at maximum

I rcv = 0.02 A Vcc = 13.0 V I tx = 0.31 A Freq. = 7.042 MHz

F (MHz)	P (dBm)	P (W)	Delta (dB)
7.042	34.5	2.82	0.0
14.084	- 3.2	4.79E-04	37.7
21.126	-30.0	1.00E-06	64.5
2.790	-13.5	4.47E-05	48.0

Notes:
The rig was cold for this test. After converting dBm to Watts, the power looks suspiciously high - a goof? The last entry in this table was the first sideband of what looked like a DSB-suppressed carrier spectrum. Probably a mixer product. (Only the highest peak was measured.)

Second Test: a look at harmonic energy as power is reduced

Setting	F	2F	Delta
(%)	P (dBm)	P (dBm)	(dB)
100	32.4	-1.4	33.8
90	33.7	-2.5	36.2
80	32.2	-8.5	40.7
60	27.8	-9.5	37.3
40	-3.0	-35.0	32.0
20	-29.0	noise	noise
0	-32.0	noise	noise

Note:The "setting" is for the power control Potentiometer.

Third Test: a look at harmonic energy as frequency is varied.
Power output was set for the cleanest output near maximum power out. Power = 2.2 W

Freq.	Setting	F	2F	Delta
(%)	(~MHz)	P (dBm)	P (dBm)	(dB)
0	7.02	33.5	-3.9	37.4
30	7.03	33.7	-3.9	37.6
50	7.04	33.5	-3.7	37.2
70	7.04	33.5	-3.5	37.0
100	7.04	33.5	-3.8	37.3

Fourth Test: look at effects of changing Vcc a bit

Vcc	F	F	2F	Delta
(Vdc)	(MHz)	P (dBm)	P (dBm)	(dB)
12.0	7.04	33.1	-3.9	37.0
13.0	7.04	33.5	-3.7	37.2
13.8	7.04	34.1	-3.5	37.6

Note:
Output was set below the maximum at a point where the harmonic was down.

Observations:
The recommended setting for the power pot (90%) is good, since power actually peaks near this setting and is cleaner than for 100%. I noted that the ouput was cleaner just below the peak power output setting. 72, Robert Neece, N4JEO

NW80/20 Review

by Preston Douglas, WJ2V
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MFR: Dan's Small Parts and Kits
ADR: 1935 So. 3rd West No. 1, Missoula, MT. 59801
TEL: 406-543-2872

DESIGNER: Roy Gregson W6EMT 13848 SE 10th St., Bellevue, Wa 98005
MODEL: NW80/20 (Northwest 40m tested)
SIZE: 3" x 5 1/4" x 5 7/8" Radio Shack #270-253A (included, but not drilled/punched/or labelled)
WEIGHT: Heavy, guessed at 3lbs, partly due to heavy gauge steel of cabinet top making package very sturdy.
PC BOARD: Single sided, Silk Screened, perfect fit in above cabinet
MANUAL: 22 Pages, quite excellent with few errors. Construction is step-by-step with modular circuit assembly of subcircuits, tested in stages, giving the builder a great sense of confidence in the probability of success at completion.
POWER: 12-13.6VDC
RX Current: 46 ma @ 13.6; 43ma @12v
TX Current: 1.1A @ 13.6 for 5w; 950 ma @12v for 3.5w (will put out 5w at 12v, but would then exceed 5w at 13.6)
MODE: CW
KIT: Yes. Complete—builder will likely want to throw out RCA chassis mount jacks in favor of 1/4" and 1/8" jacks and the crummy DPDT slide switch for AF filter will routinely be junked for a toggle by most builders. That switch is unworthy of the rest of the kit.
BANDS: Monobanders available on any single band: 80, 40, 30, 20.
VFO: 2.8-3mHz. Reduction cap with nice brass dial collar with clear plastic/red line pointer. Builder makes dial lines/markings on face of cabinet. (Try white contact paper with rub off lines and numbers, covered with clear contact paper—neat, good looking and no spraying.)
DRIFT: Not measured, and none noticed.
RX: Superhet, discrete VFO->602->xtal fil->1350->602->386->AF filter
TX: 5w++ (will go to 7-8w at least, if you want it) board mounted pot for 0-5+watts with builder supplied panel mounted power control pot option.
FILTERS: 4 pole xtal and switched AF
SELECTIVITY: not measured. Estimate 1000 Hz. or 400 Hz. w/ AF fil on.
RIT: Yes
GAIN: AF only
AGC: No
PREAMP: No
ATTENUATOR: No
SPEAKER: Drives a 5" easily and LOUD (Builder supplies the speaker).
METER: Yes, but...this is a relative power meter only, no sig meter (no AGC, so no sig voltage availble) and hardly worth the effort to cut the cabinet to fit the meter. Meter wasused for construction testing, and was useful there.
Notes: I am the kind of consumer sellers must dread. First, I have no hesitation corresponding, writing, and complaining, and I generally make a pain in the ass of myself with kit makers. My NW 40 worked off the bat, but I didn't like the very loud thump on changeover to receive. I worked with Roy, W6EMT, the designer who couldn't have been nicer or more concerned, and he eventually created a gimmick cap to cure my unusual problem. (Created by my ignoring cabinet templates and putting controls in such positions that inductive loops were created.) I paid Dan's the $3.00 he asked for a look-see copy of the manual (refundable against an order), and the manual sold me. One part I liked was that the manual includes Roy's address for kit problems. (Cost: $25 ppd which seems very fair to me.) Every kit builders nightmare is a dead radio at the end of 30 hours of work with no one to help rescussitate the lump. That is always my fear with

Radiokits, even though I really like their tiny size and overall performance. This kit will outperform everything in its price range, and I include even the venerable and excellent OHR kits in this price class (it suffers due to excess size, receive audio and 2 watt output)

Price of this kit is $99.95 + 3.75 postage. Don't go for the stripped $70 version as it does not include the very good AF filter, nor the meter, case, knobs, dial collar etc, all of which are good, and worth 30 bucks.

Dan's doesn't take phone orders because they don't accept plastic money. You have to send him a MO or check (They may wait to clear the latter so MO is fastest.) 72, Preston WJ2V

Fabricating Printed Circuit Boards

By Daniel Wee, 9V1ZV
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Since the beginning of my electronics construction hobby, I've just about built circuits in every possible way I could think of. I still remember my early days when I actually had germanium transistors screwed down on a block of wood. That was before I acquired my first soldering iron. I then progressed to the well- known "ugly" construction technique where component leads were simply soldered together. Other methods I remember include, breadboards, matrix boards which were quite popular at one time, wire-wrapping, board-excavation and printed circuit boards. Of all these, I have found the printed circuit board method to be one of the most satisfying and aesthetically pleasing, so far. This does not mean that it was an easy method, in fact, I had avoided circuits requiring printed circuit boards until I had tried everything else, and there was a good reason for this. There are also limits to what you can produce yourself, for example, you will not have the facility to fabricate through-plated boards or multi-layer boards. For these, if you ever need them, its best to go to the PCB manufacturer to have them made for you.

Like many, I had supposed, rightly, that the fabrication of printed circuit boards was a tedious process, requiring a lot of basic tools and equipment which I did not possess. As such, the whole process of fabricating a printed circuit board had remained pretty much a mystery to me until I entered the field of radio electronics. I discovered then that the parasitic capacitance and electrical properties of other construction methods were simply unsatisfactory for circuits operating in the RF regions. Thus began my quest for the printed circuit board. The purpose of this article is to briefly outline the various methods and steps of producing a usable printed circuit board.

Basic Theory

The whole idea of making a printed circuit board is really a chemical process of removing copper from the circuit board at the right places, in order to leave behind tracks suitable for carrying current as required by the circuit in question. Boards can be bought which come with copper clading one or both surfaces, used for making single or double sided PCBs respectively. A visual survey of the board reveals an uninteresting copper surface with no holes or tracks. The constructor must find some way of removing the copper in order to obtain a circuit pattern which can be used. One way to do this is by "excavating" the board with a sharp cutting tool to remove the copper. This proves to be an extremely tedious method and can only be used for the simplest circuit patterns. It is sometimes useful for making quick and dirty modifications to an existing pattern.

The standard way of creating a pattern, however, is by means of a method known as "etching". Etching is a chemical process whereby the unwanted copper is removed by a process of reduction, a chemical reaction, which "corrodes" away the copper. This is often achieved by immersing the copper clad board into a solution of Ferric Chloride or Sodium Persulphate (I think). Upon contact, a reaction occurs which reduces the copper on the PCB to copper chloride which comes off the board. Ferric Chloride has now become a controlled substance in some places because of its toxic and environmentally unfriendly nature and this makes it difficult to obtain from the usual sources. Sodium Persulphate is the substitute for Ferric Chloride but has not arrived at the shops here yet. Either of the etchants can be obtained in liquid or in crystallized form. Nowadays, they are rarely found in liquid form because of the high rate of oxidation which renders the chemical useless. More often than not, they come in the form of dehydrated crystals which are mixed with water to produce the etching solution. This solution is then used to etch the boards.

If you have been asking yourself how the chemical can be prevented from removing all of the copper, then you have asked an appropriate question. There are a number of methods by which this can be done. The whole principle lies in preventing the etching solution from coming into contact with the copper you wish preserved on the board. This can be by means of a water-proof tape on the board, rub-on transfers, marker ink, etch-resist ink, toner ink, plotter ink or photo-resist. In short, any method that can protect the board from the chemical solution is usable. Some methods are easier than others, of course, and the method to use depends on a number of factors, such as complexity of the pattern you want to produce, the density of the tracks, the boards available etc.

Once you have, for example, drawn a pattern onto the clean copper clad board with etch-resist ink, you may immerse the board into a properly prepared etching solution for the etching process. This can take from 5 to 30 minutes or more, depending on the concentration of the etching solution. After that, the board is removed from the solution, revealing a board where the unmarked portions of the board has no copper on it, the board material beneath being now visible, and the marked parts of the board still having the ink in it. Once the ink is removed either by sanding or by the use of solvents, the copper will become visible. The one last remaining step is to drill the holes for component leads in the right places and the board is ready for use.

That is generally what happens in the process of fabricating a PCB. Time does not permit me to cover all the methods that you can use so I will highlight some of the major steps in the following text.

The Copper Clad Board

Boards suitable for etching can easily be obtained from parts suppliers and come in a number of varieties. Typically, there are two major types of board materials that are used for the base board, fibre-glass (glass-epoxy) and phenolic paper. Fibre-glass boards tend to be tougher, look better and probably has slightly lower surface capacitance properties, as well as being the more expensive of the two. Phenolic paper, on the other hand, is easier to cut and drill though it tends to crack or fragment as it is more brittle, and cheaper. Both types can be used for homebrew construction projects as the mentioned RF properties are quite insignificant until VHF frequencies and above.

You will find single-sided copper clad boards as well as double sided ones and you choose the type of board appropriate for the circuit board you wish to fabricate. Double sided boards are normally used for RF related circuits because it offers a stable one-point ground-plane which helps stability and prevents unwanted oscillations or ground loops. However, producing double-sided PCBs requires high precision tools and I will only

briefly mention some of the methods for producing simple ground-plane double sided boards later. This should be sufficient for a start.

You will also come across boards which are "pre-sensitized" or "photo-sensitized" which are used to produce photo-resist patterns. These boards are typically much more expensive than the plain boards because of the photo-resist film that has been pre-deposited over the surface. Such boards often come in light-proof wrapping with an additional layer of opaque plastic on the board surface which will not be removed until ready for exposure. I will detail this technique below.

Before you get started with the boards however, you will need to cut the board down to the size you need. Normally boards are sold in several sizes so you may pick either a large sized board and cut it up as you need, or select a size that is closely matched with your required size to minimize the cutting. The boards can be difficult or easy to cut, depending on the material of the board and its thickness. Average boards are about 2 mm thick and are quite tough and difficult to cut. Some boards come in 1 mm thickness and can be cut using a heavy-duty cutter. This type of board is usually quite flexible and thus the bending will not damage it. The thicker types on the other hand, will tolerate little bending before fracturing or fragmenting. Cutting can be achieved using a hobby saw with a fine-serrated blade. Thick saw blades are not suitable for this. Sawing should be done slowly and gradually in order not to damage the board. Saw perpendicularly to the board, which should be clamped down to the work-bench firmly using a C-clamp or a similar device. Alternatively, you can use a heavy-duty Exacto knife to engrave the border lines of the appropriate size. When using this method, it is not necessary to completely cut through the board. Once about 3/4 of the thickness has been cut, you can usually snap the board along the engraved lines. It is important to engrave BOTH sides of the board, otherwise you will not get a clean break. This method is very tedious, time consuming and tends to destroy your blade, especially when cutting fibre-glass boards. It can be used when a hobby saw is not available. Try not to scratch or damage the copper surface when doing this. After the board has been cut down to size, use a medium sized file to smooth out the edges for a nice finish.

The Etching Process

The next most important component you require is the etching solution. As of now, very few shops will sell Ferric Chloride crystals to unlicensed buyers and Sodium Persulphate is not publicly available. There is a good reason for this but it means a lot of inconvenience for the home constructor.

Ferric Chloride is most commonly available as dehydrated crystals and sold in plastic containers. It is very important to keep these crystals in a dehumidified environment as it tends to combine with moisture in the atmosphere and turn into a really messy and staining liquid. Be forewarned that this substance stains permanently on clothes and even some plastics or ceramics, is highly corrosive, carcinogenic and toxic. As such it should be kept out of reach from children and water. For the same reasons, it should not be discarded into the public drainage system.

Sodium Persulphate is a white crystal and though it is environmentally more friendly that Ferric Chloride is, similar precautions should be taken and care exercised when dealing with concentrated chemicals of any type. This substance is considerably safer however. For one, it is endothermic when dissolved in water and the resultant solution is a clear and non-staining solution. It is also slower acting than Ferric Chloride and probably needs more agitation and perhaps a little warming up. A good way to speed up the reaction may be to dissolve the Sodium Persulphate crystals in boiling water. Take all necessary precautions to avoid scalding.

The way to prepare the solution is to mix the crystals into some water, usually 1 part crystals to 5 parts water. This is just a guide and once you understand the process you can easily produce higher concentrations to etch boards more quickly. You should also be aware that the process of hydrating these crystals is a highly exothermic one so do not be surprised if the water starts to boil. As such, one should NEVER throw any substantial amount of crystals into the water. Similarly, one should NEVER add water to crystals, always crystals to water.

Normally, a plastic tray suitable for immersing the circuit board is filled with about 2 cm of water. The crystals are then added to the water BEFORE putting in the board, using a plastic spatula or any other suitable instrument. The instrument MUST be dry before applying to the crystals. Never leave the crystals exposed to atmospheric air for long. As soon as you have taken out enough crystals, wipe dry the rim of the crystal container and re- seal it in its air-tight container and store in a dry place out of reach of children. Do not get the crystals or solution on to your skin or eyes, and if you do, rinse under cold running water to remove it. See a doctor immediately in the event of ingestion. As you add the crystals to the water, the water will change color, to dark brown if using Ferric Chloride, and you should notice some heat being produced. Do not be too worried by the heat as it is useful for the etching process. Do not inhale any fumes produced during the entire process, these are poisonous and though in very small amounts, may cause asphyxiation (Chlorine). All this should be done after you have readied the board for etching. All instruments coming into contact with the solution should be non-metallic. Stir the solution until all the crystals have dissolved to produce an evenly colored solution. Now the solution is ready for use. Try to use it while it is hot so this step should always be done after your board is ready.

Put your resist-masked board into the solution slowly so as not to cause a splash. Remember that the solution is very hot sometimes. Once the board is completely immersed, regularly agitate the tray and pay attention to the exposed copper. After some time, the exposed surface will appear dull, not necessarily evenly. Then after more agitation you will see patches of circuit board becoming exposed. Do this until ALL the unwanted exposed copper surface has been removed and the board material is visible beneath it. This may not be easy initially as the etching solution may obscure your view of the board. It is therefore good to have a deeper tray which allows you to tilt the tray to expose the board. Normally, surfaces with less exposed copper tend to etch faster that surfaces with more copper, and once you are more experienced, you may want to use a stronger concentration for surfaces which require a lot of etching. The copper corrosion normally starts from the edge of the board and works its way to the center. Be sure to keep on agitating the board so that the resultant copper chloride (a powdery precipitate black in color) will get swept off the surface. This will speed up the etching process.

While it is important to make sure every part of the board is sufficiently etched, DO NOT keep the board in the solution longer than absolutely necessary. This is because extended exposure will allow the etchtant to get under the resist and affect the fringe of your tracks, resulting in ugly patterns. Experience will soon tell you how long to leave it in for the concentration you use. Normally everything should be done in 25 minutes but it may be less, depending on the size of the board, exposed surface, and the concentration of the solution. Proper timing is especially important when very thin running tracks are involved.

If you are doing double sided boards, you should at some point, turn the board over. In this case, unless you have special holders, you should not over agitate the tray as the copper chloride precipitate which sinks to the bottom of the tray is rather abrasive and may scratch off some of the resist on the bottom side. Other than that, the procedure

remains the same.

Some of the shops sell special etching tanks which stand vertically and have a little electric motor to automatically agitate the tray. This is not suitable for small scale productions as the tank normally requires large amounts of etching solution to fill up, and cost quite a lot to buy. For me, the above method is more than sufficient.

Drilling of Holes

The drilling of holes is typically the last stage of the PCB fabrication process so this may seem a little anachronistic. Nevertheless, this is the last common step of the various methods of PCB fabrication so I thought it'd be good to cover it now.

Clearly, you will need to drill the holes yourself if you intend to put components on the board. In some surface-mounted designs, especially common with microwave and UHF circuits, this may not be necessary. Unfortunately, you cannot use your trusty Black & Decker power drill for this purpose because of the excessive speed of the drill and the oversized drill bit. A hobby or hand-drill is suitable and cheap ones, both battery powered and mains powered, can easily be found in Singapore for under $50. You will need to get a few common small sized drill bits for PCB use. The most useful by far is the 0.8 mm drill bit. The 1 mm and 2 mm drill bits also come in handy when drilling larger holes on the PCB. Generally, drilling PCBs do not require a lot of effort because the PCB material is relatively soft and easy to drill. Be sure to get spare bits because the bits tend to break easily and are rather brittle due to their small cross-sectional area.

You should position the drill bit perpendicularly to the PCB for drilling any holes, and always maintain a steady and firm grip of the drill. If necessary, you may want to use a sharp instrument to slightly indent the spot you want to drill, as a guide as sometimes the drill bit tends to spin away from the point and scar the rest of the copper surface. Usually though, properly made boards should have these guides etched in. Do not apply undue force as this might cause the bit to break or the board to crack. Apply a steady force on the drill until you feel the penetration of the PCB. It is also advisable to have a piece of unwanted even wood surface beneath the board so that you won't destroy your workbench or your drill bit. Soft-wood is best but other soft material will also do, eg. old hard cover books.

Normally the drilling process produces a substantial amount of debris which will obscure your drilling template. Thus you will want to drill holes systematically so as not to miss any holes inadvertently, and to drill a section at a time, clearing away the debris as they accumulate. Do not have the fan blowing while you are doing this or your XYL will be all over you for messing up the place! Once you have drilled all the holes, inspect the board for undrilled or partially-drilled holes. Also, be on the lookout for tracks that may have come off as a result of the drilling. This may sometimes be the case when drilling large holes on a small pad. Remove burrs from the holes and then your board is ready.

Masking the PCB

As was mentioned in the basic theory section, there must be a way of controlling which parts get etched and which parts of the board don't. I also briefly mentioned a number of methods. Here I will highlight two of the methods most relevant to us homebrewers. Direct penning onto the board using etch resist pens and photo-resist.

Using Etch-Resist Pens

You can actually draw the desired tracks or patterns onto the copper clad board with etch resist ink. Get a normal copper clad board that has been cut down to size, washed

and dried completely. Do not soak the board in the water for too long or the water may damage the board. Be certain to make sure that there is not grease on the board or oxidized surface. If necessary clean the board with some mild abrasive to obtain a shiny surface. Avoid touching this surface with you fingers or dirtying it. This will ensure a more even etching later on. There is no need to buy special etch-resist pens for this purpose though you could do so. For simple purposes, permanent markers or Indian ink seems sufficient for the job. There are advantages and disadvantages of using such a method. On the plus side, this is a very convenient method for producing one-off, not too intricate or complex patterns, and can be done rather quickly. However, you cannot obtain high resolutions tracks or any degree of evenness with this method. The results tend to look amateurish. Just as a reminder, the tip of the etch-resist pen tends to dry up quite quickly so the pen should be re-capped tightly when not in use. Have a pice of paper near by to get the ink flow even before trying to mark the PCB with the pen.

Sometimes you can buy rub-on transfers for tracks or pads which you can incorporate as part of your pattern to make it look neater. On the whole, however, this method is reserved mostly for experimentation or very simple circuits with broadly spaced tracks. Alternatively, you can also use special tracking adhesives to paste out your tracks. Either way, the end result is rather coarse and difficult to reproduce.

Recently, there are available in the United States, special transparencies which you can laser print or photostat your track onto, and then iron-off the pattern from the transparency onto the board. Below is an excerpt which says something of this method:-

From: gary%ke4zv.UUCP@mathcs.emory.edu (Gary Coffman)

There is a special transparency film called Tec 200 marketed for this purpose, but I've found that Avery overhead transparency film works just as well, and is available at most larger computer or office supply stores. You just print your board layout to the transparency with your CAD package laser driver, remember you want a mirror image, and then iron it onto the copper. The copper needs to be clean, just as it would be for any resist application. You need a fairly hot clothes iron to fuse the toner to the copper. I use a regular home iron set for "cotton" and use an old Tee shirt between the iron and the film. After it cools, you can peel the transparency film off the circuit board and the toner will remain behind as the resist pattern. There may be a few pinholes or gaps where the toner didn't transfer well. You can patch them up by hand with an ordinary resist pen.

Note you can also use Avery film in ordinary copiers to generate a transfer from magazine artwork or hand drawn paper layouts. Of course when laser printing the film, you need to adjust your CAD driver so that the laser printer gives a properly dimensioned copy, and when using a copier, one with infinitely adjustable "zoom" feature is handy for the same purpose. If the artwork is "normal", you can first make a copy to a transparency, flip it over, and use that as your master for making the transfer transparency.

Works good, costs little.

Another method I have come across of directly masking the PCB is through the use of flatbed plotters. Apparently, the ink used in these plotters are etch-resistant and if you can design the board using CAD software, you should be able to plot the mask directly onto the board using the plotter. I have not tried this myself but a friend of mine has and reports good success.

Photo Resist Masking

This is probably the best way I know for making nice looking PCBs. Unfortunately, the technology behind it is rather obscure for many people entering the hobby and remains a mystery for others. Thus I will try to demystify the process here, with some luck. Contrary to the belief of many, the photo-resist method does NOT produce tracks on the

PCB, it only produces a mask or pattern of etch-resist material, after which the board still needs to be etched like in all the other methods.

In this method, you need to get your pattern or mask onto a piece of clear transparency. This is usually done by laser printing direct on to the transparency, or photostating on to it. This means that anything that can be photostated, eg. patterns from magazines or from the ARRL handbook, or even texts and pictures, can be etched. This adds a number of advantages. For one, it is much easier to draw patterns on normal paper than on the copper surface. There is no need to use special etch resist ink for this purpose. You can also draw lines with higher density and definition as well as accuracy than you can using the direct method. You can use PCB layout software to print out computer generated patterns as well as including printed texts as part of the pattern. The possibilities are numerous. It should be noted that all the patterns must be black and white, no grays, and that the transparency must be clear, clean and colorless. Transparencies used for OHP presentations are suitable for this purpose. As an additional hint, you should try to get the transparency prepared such that the side with the toner is also the side that will be in contact with the PCB during exposure. This yields slightly better defined lines as there is then only one clear edge. It does not matter that the print is not completely opaque when you look at it against the light, usually normal photostat contrast is sufficient. You may want to cut the transparency to the size of the PCB for easier handling. Do not scratch the transparency as the toner may come off. If you notice missing tracks, you can still fix it by drawing on the missing tracks using an opaque black marker pen. If you notice excess tracks, slowly scrape off the toner/ink gently using a paper cutting blade. One advantage is that once you have produced one mask, you can use the same mask to produce a number of identical boards. When producing the mask, you should try to get it so that the emulsion side (the print side) is the side that contacts the PCB. This way when you expose the board, there is a minimum of shadow and fringe effect at the edges of the tracks and results in higher definition tracks.

The copper clad board must be specially prepared or sensitized by spraying a film of photo-sensitive masking material on to it. This spray is normally available in a canister and leaves a coat of clear green color (usually) when applied to the board. Spraying must be even and a sufficiently thick film must be deposited and dried before commencing exposure. All this should be done in low light/UV conditions as the spray is photo-sensitive. Alternatively, and more conveniently, boards that have been presensitized can be purchased quite easily from the shops. In any case, the spray is very expensive and not easy to use. These pre- sensitized boards come in light-proof wrapping which you may remove. The boards have a second protective plastic film over the surface so you need not worry about accidentally exposing the boards. The rate of reaction is way slower than that of the camera film so you need not be overly concerned of over exposure. Just be sure that you are not doing this under intense fluorescent or sunlight. The second protective layer is an opaque adhesive plastic layer which is stuck to the board surface. This is usually white in color. Do not peel off this layer until you are ready to expose the board. If you do accidentally peel it off pre-maturely, store the board in a dark place until you are ready. In any case, these boards need to be stored in the dark and in a cool environment.

Once your transparency is ready and you have cut the board to size (without removing the protective layer), prepare yourself a clear piece of flat glass such as that found in picture frames. Be sure that the glass surface is clear and clean, and that its size exceeds the size of the PCB. This glass is used to hold the transparency to the PCB during exposure. Put the PCB on a flat surface and align the transparency over it, making sure that when you look at the transparency, you see the exact image of the track/pattern that you

want, NOT the mirror image NOR the negative. Be sure your UV source is NOT active. Once you are ready and have double-checked every detail, slowly peel off the protective layer from the pre-sensitized PCB and replace it on the flat surface. Under the protective coating you should see a hard and dry, green film over the copper. Place the transparency correctly over the PCB and align it. Then, place the piece of glass over the transparency to press it firmly to the PCB surface. Once again check your alignment and then expose the board to the UV source.

The UV source can be a table top fluorescent lamp, or the sun, or special UV lamps. In all cases the UV content is not the same, thus exposure time varies. In my case, I use a table top lamp with an 11-watt fluorescent tube and place it about 2 to 3 inches above the board for 6 minutes to give me a properly exposed board. Under the afternoon sun on a clear day, it takes about 8 to 15 minutes to get sufficient exposure. Under UV lamps, the period may be as short as 30 to 90 seconds depending on the intensity of your source. Experimentation is the key to knowing how long to get the right exposure. Excessive exposure will damage the board and under-exposure will be equally disastrous. Once you have determined the correct exposure time, however, it is the same every time when using the same type of board, so be prepared to experiment a little with your first few boards. NEVER move or adjust the board once you have started exposure. Once you get good at it, you can even expose a number of boards simultaneously. Some types of board will exhibit a slight color change on the exposed parts once they are done but do not count of this method to determine when to end because the change is barely perceptible. Note that if you are using a UV lamp, be careful not to look at the light direct as it may damage the eyes because the iris of the eyes do not respond too well to UV and may result in retinal burn.

During the few minutes of exposure, get the developing solution ready. This solution is normally sold in the same shops where you purchased the PCB in the first place. They sometimes come under the name of POSITIV 20 or something similar and consists of an alkaline solution. Have this ready when you finish exposing. If you observe the board carefully, you may notice that the exposed portions are a little lighter green in color than the masked portions. This allows you to actually see a faint trace of your masking pattern on the exposed board. Rinse the exposed board in the developer solution and if properly exposed, you will see the exposed parts of the green photo-sensitive film dissolve in the developer solution. Once the unwanted parts have been completed dissolved and washed away, rinse the board under cold running water to remove any remaining developer solution. You should now see a very clearly defined, green, image of your original pattern on the PCB now. Dry the board carefully, making sure that you do not accidentally scratch off the resist/film. At this point you can still make corrections to the pattern using etch-resist pens or by scraping off resist/film from excess sections. Once everything has been confirmed, put the board aside and prepare for etching as outlined above.

Making your own PCB layout masks

There are a number of ways you can use to produce your own photo-exposure masks and layouts. Typically you want to draft out the layout on paper first before committing it to the final mask. Be sure to take into consideration RF paths and good grounding. There are a lot of considerations that need to be taken into account of in the design of a good PCB layout. Once you have drafted out the layout you can use hand-drawn masks, or combine hand-drawing with the use of Decal-Dry or rub-on transfers. These methods are suitable only for low density/complexity designs. The easiest way however is by the use of CAD software. There are some easy to use but fairly competent PCB CAD shareware

available and if you intend to produce PCB designs of your own, you should be familiar with such software. Describing how they work is outside the scope of this article but among the features of such software, are their flexibility, multiple printer support, multiple layer support, silk-screening support, automatic drill guides on pads, auto-routing, easy editing, free/shareware, standard component templates and the list goes on and on.

Summary

In summary, let me outline the steps and tools involved in the direct PCB fabrication method. First, the tools and materials:-

a) Ferric Chloride or Sodium Persulphate crystals (or solution).
b) A plastic tray big enough to immerse the board fully.
c) The single or double sided copper clad board.
d) Etch resist pen and/or transfers.
e) A small medium speed drill with 0.8 mm bits.
f) Hobby saw or Exacto knife to cut the PCB down to size.
g) File to give the board a good finish.
h) Mild abrasive for removing the resist from the PCB after etching.

The steps involved are as follows:-

a) Prepare a draft of the desired layout.
b) Cut out the required size of the copper clad board.
c) File the edges of the cut down board for a smooth finish.
d) Transfer the layout to the copper clad board by drawing it on with the etch resist pen or transfers.
e) Double check for errors.
f) Prepare the etching solution as by adding 1 part crystals to 4 or 5 parts water. Refer to section on etching.
g) Immerse the masked board into the tray with the etching solution.
h) Agitate the tray slightly for about 15 to 25 minutes, paying attention to the extent of the etch.
i) Remove board from tray when completely etched.
j) Rinse board under cold running water from the tap.
k) Dilute used etching solution with lots of water before disposal.
l) Use the mild abrasive to remove the etch-resist from the board.
m) Use the drill to drill the appropriate holes for the components.
n) Remove burrs from the holes.

For the photo-resist method, the tools required are the following:-

a) Ferric Chloride or Sodium Persulphate crystals (or solution).
b) A plastic tray big enough to immerse the board fully.
c) Pre-sensitized copper-clad board.
d) Transparency suitable for photostating.
e) UV light source.
f) Developer solution.
g) A piece of clear glass to hold mask in place.
h) Marker pen or transfers.
i) A small medium speed drill with 0.8 mm bits.
j) Hobby saw or Exacto knife to cut the PCB down to size.
k) File to give the board a good finish.

l) Mild abrasive for removing the resist from the PCB after etching.

The steps involved in the photo-resist method are as follows:-

a) Prepare the masking pattern on a piece of white paper.
b) Transfer pattern to the transparency by photostating.
c) Cut the pre-sensitized board down to size.
d) File the edges to remove unevenness.
e) Place transparency on the board to check alignment.
f) Peel of protective layer from board.
g) Align the transparency on the board.
h) Place glass over the transparency to hold it firmly in place.
i) Place the UV source over the board and glass.
j) Activate the source and expose board for a suitable period. Read above.
k) Rinse the exposed board with the developer solution to dissolve unwanted resist.
l) Double check for errors.
m) Prepare the etching solution by adding 1 part crystals to 4 or 5 parts water. Refer to section on etching.
n) Immerse the masked board into the tray with the etching solution.
o) Agitate the tray slightly for about 15 to 25 minutes, paying attention to the extent of the etch.
p) Remove board from tray when completely etched.
q) Rinse board under cold running water from the tap.
r) Dilute used etching solution with lots of water before disposal.
s) Use the mild abrasive to remove the etch-resist from the board.
t) Use the drill to drill the appropriate holes for the components.
u) Remove burrs from the holes.

Conclusion

The real key to learning to make PCBs is to do it yourself. In this article I have tried to provide a general idea of the process of fabricating your own PCBs and have purposely included a number of cautionary and warning notes so that the reader will be aware of the hazards involved. On the other hand I have been making my own PCBs for about 8 years now and have not suffered any side-effects or harm. Hopefully, this article will open new doors and possibilities for the homebrewer and that through homebrewing, one very significant aspect of the original spirit of Amateur Radio may be restored. If there should be further inquiries, I will be more than glad to help out. 73, Daniel Wee

The Key 7 - Opening the Door to Milliwatting

by Steve Ortmayer, G4RAW

[Editors Note: This article was originally published in the April 1995 issue of Practical Wireless. It is a British amateur radio publication, and is an excellent addition to your library. Rob Manion, G3XFD, is the publisher, and is quite active, both on the air and at ham fests. He attends Dayton yearly, in fact, Practical Wireless sponsors an annual tour to Dayton from England. Subscriptions to Practical Wireless are $45 per year for 12 issues. If you would like to subscribe send a check or money order made out to Practical Wireless for $45, US funds. The address is: PW Publishing Ltd., FREEPOST, Arrowsmith Court, Station Approach, Broadstone, Dorset BH18 8PW. I recommend the publication

highly, it is one of my favorite! Thank you to Rob Manion for kindly granting permission to republish this article. KI6DS]

Personally, I've never felt the need for more than a few watts output since I obtained my call in 1983. But I had never tried less than about 1W. Would it be possible to make contacts with 100 mW? I had read in Sprat, the journal of the G-QRP Club, that QSO's have been made with very low power but they may have had some good high gain antennas.

My antennas are very simple wires strung between the chimneys of my house. During one 3.5MHz QSO I mentioned to the other station that my antenna was a half wave inverted V on the chimney, and he came back asking "Is it a mill chimney?".

Apparently, he had thought I said a half wave vertical! Well, most of the mill chimneys have gone now in Halifax. "Good thing too!" say the generation who slaved in them.

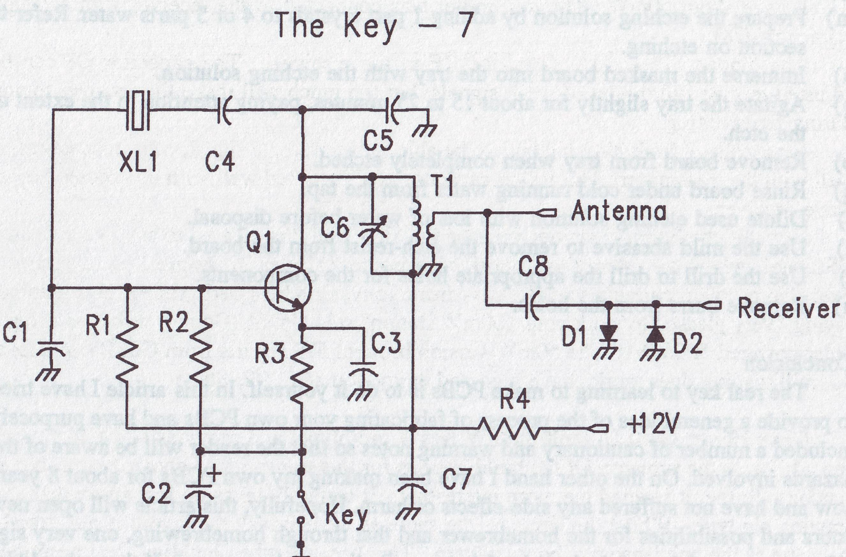

Figure 1

The circuit, Figure 1, for the transmitter is a simple one transistor oscillator and it comes from Doug DeMaw's W1FB's Design Notebook. I made two versions of the transmitter, and one used my well known drawing pin method, on a wood base with a strip of p.c. board material as a Morse key.

The version I'm describing this time is the other one I made, using a p.c. board. With this method the board is extended to form the key as in my original PW Speedbrush Morse key project.

If you would like to try the drawing pin version a wood base is prepared and the pins pushed in, following the circuit layout. The pins are tinned with solder first, but take care not to overheat them, an aligator clip can be used on the leads as a heat sink.

When all the components are in place, check the wiring and apply 12V, not forgetting that a dummy load 50 ohm resistor should be across the output. The output can then be measured with a diode probe.

Adjust C6 for maximum output which should be about 100mW. If the transmitter does not work, check the crystal and if this is in order, try changing C4 to 120pF.

You can make the p.c. board version in the usual way by copying the layout onto a bit of copper laminate board. Glass fibre board (this is the material which the appropiate PW PCB Service boards are made from) is best. This is because it has mor "springyness" for use as a Morse key.

If you're making your own board, first etch and drill the board and solder in the components. If you've got the ready-made p.c. board, drop the components into place, using Fig. 2, the p.c. board layout and component overlay as a guide.

The p.c. board is then bolted onto a wooden base with a small plastic knob to form a Morse key. The transmitter is then ready for testing.

I tried and tested a 2N4400 transistor which gave about 100mW and a 2N2222A whcih gave about 50mW. The transmitter was connected to the receiver with a 100pF capacitor (C8).

The diodes, D1 and D2, 'clip' the RF to the receiver. The capacitor C8 can be adjusted to give full output of weak signals, but too much will make the receiver thump during transmitting.

Personally, I think it's a big help to be able to listen to the signal, as it indicates all is well with the transmitter. The 100pF capacitor at C8 worked well with my simple home-made receiver.

How did the little transmitter work on the air? Well, I'm pleased to say I've got some QSL cards which are interesting. Working from my QTH in Yorkshire I had comments like: "No problem copying your 100mW from Tony, G0KPB (Derbyshire). And another saying "Very pleased to work your 100mW station" said G6NA (Dorset) who was using a Solar powered 500mW!! The 50mW version brought 579 reports from G0FPV in Essex. So, milliwatting does work...have a go and enjoy yourself. 72, Steve

Clive Hardy, G4SLU, built the PW Key-7 prototype, and provides some comments and advice on the project: Of the build options for this transmitter I chose the p.c. board version. To me, it seemed the more interesting. It certainly takes up less space than the drawing pin type. Whilst the circuit is the same as the original, the layout is not exactly the same as the published p.c. board pattern. This because when building the transmitter I only had the rough draft p.c. board drawings to work from. Fortunately, at 7 MHz component positioning doesn't matter too much, within reason.

I used the more readily available 2N2222A transistor and got the same 50mW that Steve die with the device. By increasing the number of turns on T1 Secondary from 3 to 5 turns I obtained just over 100mW output from the 2N2222A into 50 ohms. No doubt with the appropriate number of turns for the link winding 100 mW could be obtained from most small signal transistors.

Finally, in Steve's instructions he states the secondary of T1 should be wound near the 12V end of the winding T1. I didn't think winding position was that critical with a toroid, other than it should be evenly spaced. My link winding is reasonably close to the 12V end of the main winding, but when I was experimenting with the number of turns the results were the same whereever the turns were.

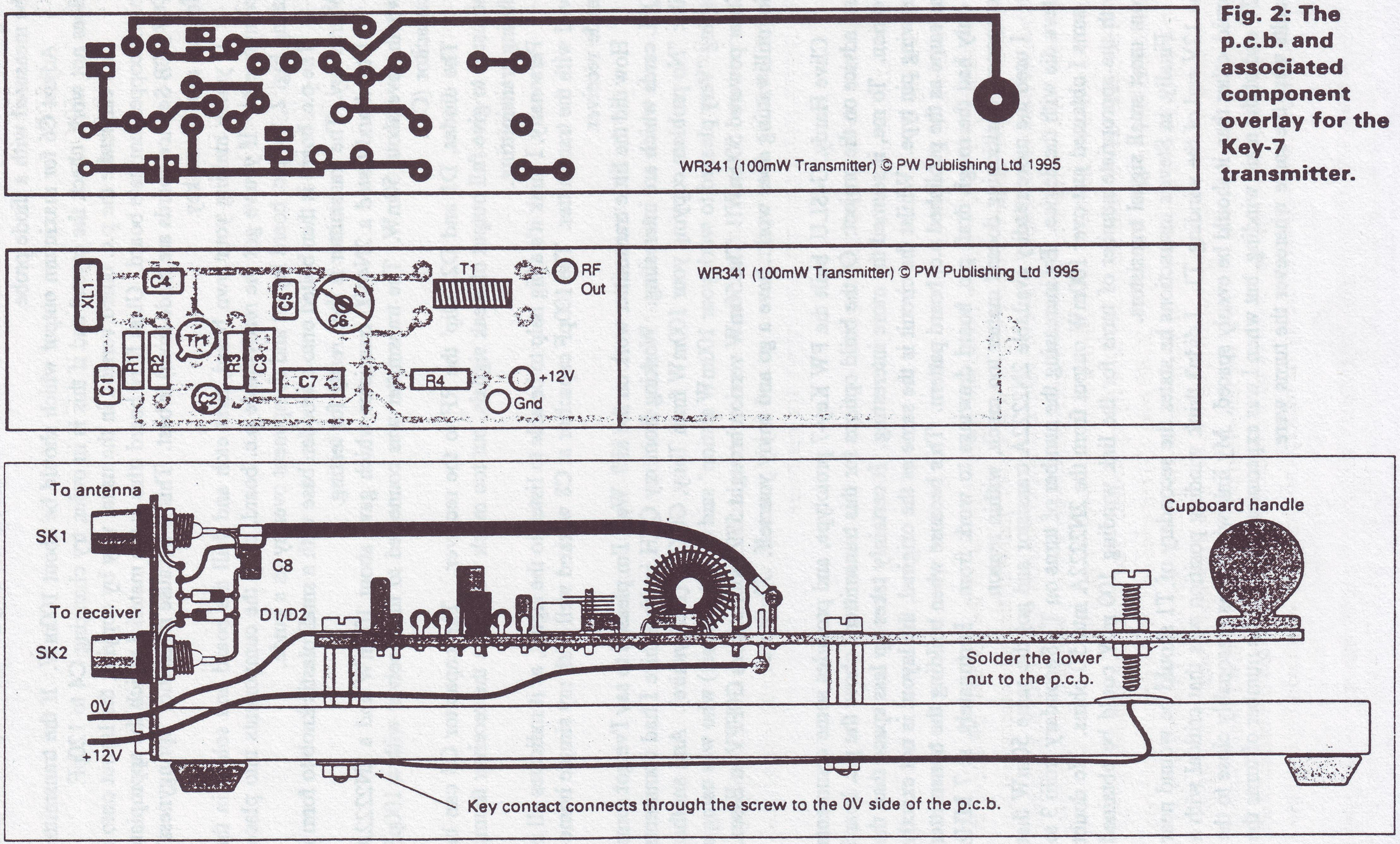

Fig. 2: The p.c.b. and associated component overlay for the Key-7 transmitter.

Parts List

Resistors:

R1	22K
R2	8.2K
R3	150 Ohm
R4	10 Ohm

Capacitors:

C1	27pF Disc
C2	2.2/25V Electrolytic
C3	0.1uF Disc
C4	100pF Disc
C5	270pF Disc
C6	100pF Foil Trimmer
C7	0.1uF Disc
C8	100pF Disc

Semiconductors:

Q1	2N2222A
D1	1N4148
D2	1N4148

Inductors:

T1	Primary 24T #26 Enameled wire on T37-6 (yellow)
	Secondary 5T #26 Enameled wire on T1 primary.

Miscellaneous:

Crystal, 40 meter band, crystal holder, pc board, suitable wooden base, drawing pins (thumb tacks) for drawing pin version, knob for Morse key, wiring, antenna sockets, 1/2 inch spacers, rubber feet, nuts and screws for hardware.

Another RFI Case Solved!

by JC Smith, KC6EIJ
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Walnut Creek, CA 94595

Working QRP with a simple homebuilt rig is truly one of the greatest pleasures in ham radio, but you do have to work at it a little harder than with the big commercial rigs with noise blankers, selectable filters, IF shift, etc. not to mention 15 to 18 dB more smoke in the coax. Add severe local QRN to the mix and suddenly it isn't as much fun anymore. That's the problem that had been confronting me for over six months.

The noise was a loud hash, sort of a frying sound. The wider the bandwidth, the worse it sounded (on AM it would hit 20 dB over S9) but even on CW the noise blanker on my "big rig" couldn't knock it out. It wasn't there all the time, and wasn't always continuous, but there was no discernible pattern like you get with a thermal cutout on a malfunctioning transformer. it seemed to be in the late afternoon and evening that I heard it most often. (Prime operating time for many of us.) I tried the obvious: pulled the breakers at the service entrance and powered the rig via battery...no change, it wasn't coming from my QTH.

I got out the AM transistor radio and started walking the neighborhood. Those little

things are surprisingly directional, and the nulls of the little internal antenna are very effective at pointing out any receivable signal source. It was everywhere: power poles, service entrances, phone or cable drops, guy wires, everywhere. I called PG&E (our local utility) and they said they had someone who could help me, but first I had to fill out a questionnaire and wait "a few days". The questionnaire was simple and informative, and might even help someone locate their problem, but I had already tried everything they suggested so I sent it in and waited. And waited... and waited. Finally I decided to take matters into my own hands.

I started listening at regular intervals and keeping track of when it started and stopped. Whenever I heard it I would tune the HF rig to AM on 10, 15 and 20 and swing the beam while watching the S meter. This told me a few things: the noise was starting at around 4 PM weekdays, not so regular on weekends, and was continuing until 9 or 10 at night. Rain didn't seem to affect it, but wind did. Best of all, I was able to get a bearing on it, about 330 degrees from my location (again, the nulls were more effective than the peak in pin-pointing the direction, but the peak answered the question of which of the two nulls was the correct one). I also learned that you can find out where your antenna is resonant by tuning the band and noting which frequency the QRN peaks at. Guess I should have known that, but it never occurred to me before.

Now i got out the little AM radio again and started driving in my truck all over the neighborhood to the NW of my QTH. I would hear the noise whenever I got near a pole, but about five blocks from home I started to hear it much louder. I parked the truck and started walking and soon found the offending pole. The racket from the radio was deafening. On the pole were a bunch of cable TV junctions and an amplifier. I thought I had found my problem. I even came back to check this pole when the QRN was silent. So was the pole.

I called the cable company and politely told them they had a leak. They sentsomeone out right away and we drove to the location. He had a scanner set up to scan all their frequencies, and he found a small leak on the next pole over, but said the noise we were hearing on my radio was not from their equipment. That left the electric utility company. I called them again only this time instead of saying I was having RFI problems, I told them I had located one of their insulators that was arcing (I lied, I admit it) and could they connect me to an engineer in service. This worked, and the engineer asked how I knew about this problem. I turned up the volume on the radio and held the phone near the speaker. I also said I had located the pole with the problem. He said he would try to get someone out here right away, and about two hours later a service technician showed up.

At first he didn't believe me when I said the problem was five blocks away. He assumed it was one of the nearby poles on my street. He did, somewhat reluctantly, agree to drive to the location. When we got there, the radio was screaming again and he became a believer. H confirmed the problem in a simple manner I hadn't thought of: he grabbed the guy wire (this was an end pole) and gave it a vigorous shake. The steady QRN on the radio became intermittent as he shook, and then went back to steady when he stopped. Problem found. Not an arcing insulator, but a bad connection that would heat up under load (when people started getting home in the evening and turning on all their appliances) and break down. When the load was reduced it would cool off and the problem would go away. A few days and a bucket truck later the problem was solved. The utility company was actually grateful, and thanked me for finding the problem for them, but nobody was more grateful than I was to be rid of that infernal noise.

So is this what is causing your QRN problem? Maybe, but probably not. There are more likely sources such as dimmer switches, doorbell transformers, touch lights, etc, etc. The main thing to learn from this is that you don't have to live with excessive QRN. If you

live in an urban area you have to learn to live with more background noise than those fortunate enough to live out in the country, but 20 over S9? NO WAY! Remember, the FCC doesn't issue licenses for spark gap transmitters. We hams have a right to reasonably quiet operating conditions on most of our bands. Be persistent, be polite, read everything you can find on RFI location & elimination, and never underestimate the lowly little AM "transistor" radio with it's built in beam antenna. 73, JC Smith, KC6EIJ

OPERATING SKILLS: For the QRP Operator

by Byron Johnson, WA8LCZ
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QRP OPERATING SKILLS:

1. Listen to existing QSO's, pick someone to call (station A), put your vfo exactly on the other guys freq (station B), now station A will hear you when station B signs off and you can him, because you're exactly in his receiver bandpass. Most cw ops use narrow filters (500 Hz or less)

2. If you want to work DX, pick a low angle of radiation antenna, like a vertical mounted in the clear or a dipole installed at the proper height (one half wavelength at your operating frequency for 40 meters, thats 20 meters or 66 ft) above ground, for the frequency you intend to transmit on. If you want to work a local contest, and DX isn't coming in, pick a high or medium angle antenna to improve your chances of making a lot of mostly local contacts.

3. Listen a lot, get to know how propagation works, pick the right frequencies for the stations you want to contact. (Your chances of working Russia are much better on 14 or 21 MHz in the middle of the day than 3.5 or 7 MHz.

4. Monitor the DX packet cluster (on two meters) to see what frequencies are active with DX.

5. The Rules don't always work the way they should. Don't be afraid to experiment if conditions arent working the way you think they should. Sometimes solar flares or local weather conditions can change reception to your area of the country. There are times when calling CQ is the only way to check out conditions. When TV or two meter reception is unusually good or bad, check the HF ham bands to see how it effects the DX. Listen right after a thunderstorm, after the lighting stops. I've heard Austrailia and Easter Island very loud, they couldn't hear me. strange conditions. If everyone's listening and no one calls CQ, not many QSO's will occur.

6. Put up the best antenna you can afford, buy the best receiver you can find, learn how to use both. don't rely on antenna tuners, they won't improve your antenna. Get your code speed up to the average speed most ops are using (15 to 20 wpm minimum), calling CQ DX at 8 wpm will get very few replies.

7. If conditions are poor, don't ragchew, send RST, name, QTH and turn it over. listening to other ops with poor proceedures won't help you. be brief, there are probably a hundred

others that also want to work the DX.

8. Don't practice your code on the air, don't learn how to use a new key on the air, don't tune up for minutes on the air, be considerate of others and they might do the same. If you tune up with a series of dits for minutes at a time, others will soon follow.

9. "Always" listen on a frequency before you tune or call CQ.

10. At field day, check out the cw ops, some of them are terrific operators, you could learn a lot in one weekend.

11. If the band is opening, signals will get stronger, so answering a weak signal is fine. if the band is closing, you should probably avoid weak signals unless its a needed state or country.

12. QRP Contesting is a great way to improve your skills, code speed, fine tune antennas, rigs, filters, keyers, logging methods. Learning to use IF filters, audio filters, IF shift or passband features on your transceiver, finding ways to change bands and antennas quickly without a tuning proceedure. So you can spend more time operating and less time fiddling with knobs. Its also a lot of fun.

13. Match you sending speed with the other guys CW speed. I keep my iambic keyer on my left side, so I can adjust the speed while I'm sending with my right hand. If he calls CQ at 15 wpm and you go back to him at 20 wpm, he probably won't answer you.

14. I like to be on a band before it opens, so I hear the DX first, work him and then sit back and listen to the pile up. Then I move up in frequency and catch a few more QSO's with others after they're worked the DX. I also hang around after the band dies, because it never really dies completely at one time. Sometimes these techniques work well.

15. Don't always listen at the same time every night. Change your operating schedule to include some late nite and early morning listening. The weekends are also a terrific time to be on the air. DX stations are in every time zone around the world. To work lots of DX, you need to be flexible.

16. Get a copy of "The Complete DX'er" by Bob Locher W9KNI, its a great read and has dozens of ideas to improve your chances of making lots of contacts and finding DX.

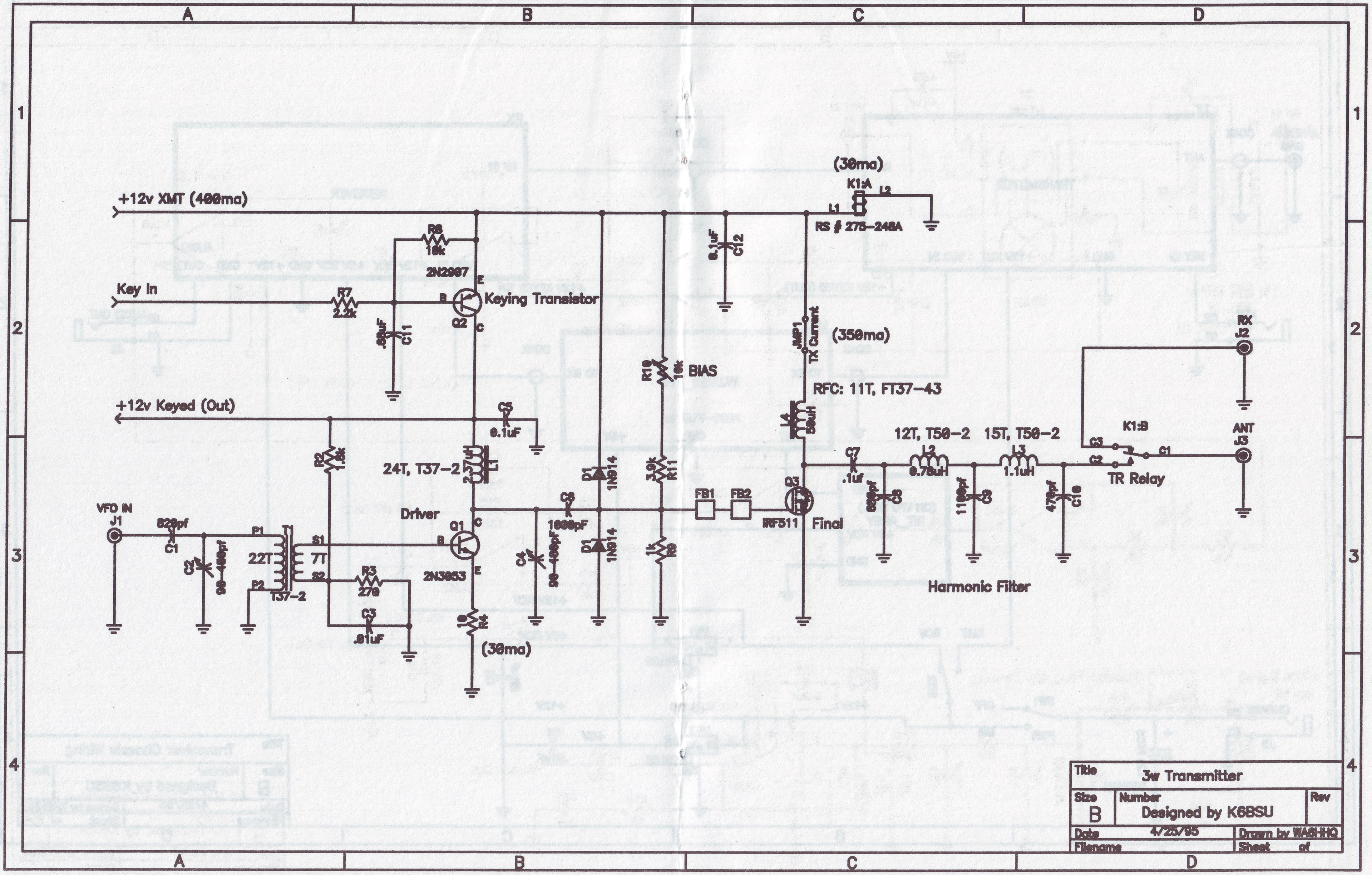
72, Byron Johnson WA8LCZ

73 SPECIAL

Floyd E. Carter K6BSU
2029 Crist Drive
Los Altos, CA 94024

The 73 Special is a complete 40 Meter CW transceiver which comfortably fits into a 7" X 5" X 2" cabinet, including a 10-cell, 12 volt 600 mah NiCd battery pack. Add only a key and a wire antenna for QSOs during a Sunday picnic outing in the park or a backpack trip.

The 73 Special got its name because it delivers 3 Watts output at 7 MHz. Unlike



+12v XMT (400ma)
Key In
+12v Keyed (Out)
R8
10k
2N2907
Keying Transistor
Q2
R7
2.2k
.68uF C11
C5
0.1uF
R2
1.8k
24T, T37-2
Driver
Q1
2N3053
VFO IN
J1
820pf
C1
C2
90-400pf
P1
P2
T1
22T
7T
S1
S2
T37-2
R3
270
C3
.01uF
R4
10
(30ma)
C6
1000pF
C4
90-400pf
D1
1N914
R10
10k
BIAS
3.9k
R11
1k
R9
FB1
FB2
0.1uF C12
(30ma)
K1:A
L1
L2
RS # 275-248A
JMP1
TX Current
(350ma)
RFC: 11T, FT37-43
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50uH
Q3
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Final
C7
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L2
0.78uH
15T, T50-2
L3
1.1uH
C8
820pf
C9
1100pf
C10
470pf
Harmonic Filter
K1:B
C3
C2
C1
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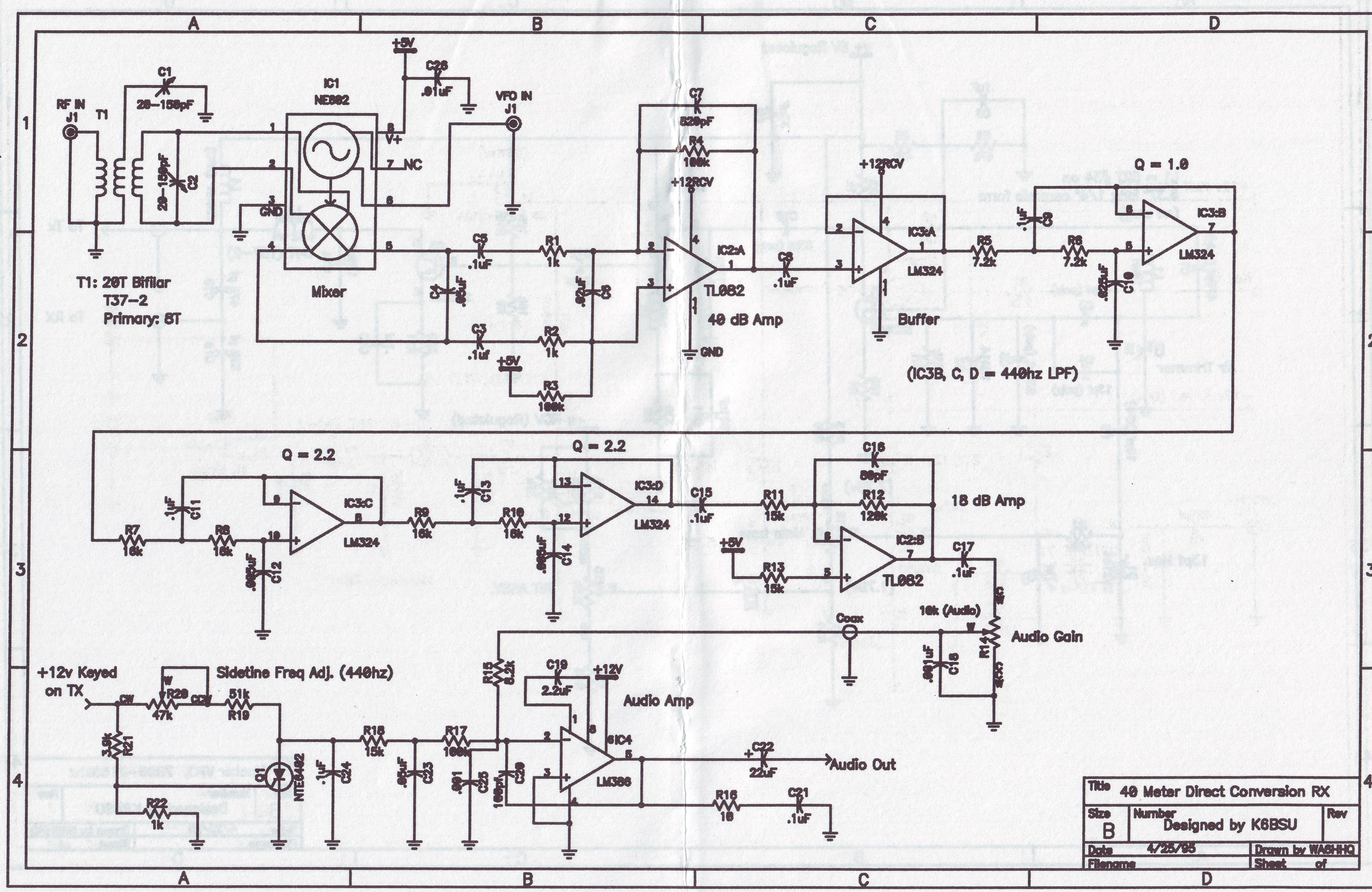
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C26
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J1
V+
NC
GND
Mixer
T1: 20T Bifilar
T37-2
Primary: 8T
C5
.1uF
C4
.001uF
R1
1k
C2
.02uF
C3
.1uF
R2
1k
+5V
R3
100k
C7
820pF
R4
100k
+12RCV
IC2:A
TL082
40 dB Amp
GND
C8
.1uF
+12RCV
IC3:A
LM324
Buffer
R5
7.2k
R6
7.2k
C9
.1uF
C10
.025uF
Q = 1.0
IC3:B
LM324
(IC3B, C, D = 440hz LPF)
Q = 2.2
R7
16k
R8
16k
C11
.1uF
C12
.003uF
IC3:C
LM324
R9
16k
C13
.1uF
R10
16k
C14
.003uF
Q = 2.2
IC3:D
LM324
C15
.1uF
R11
15k
C16
68pF
R12
120k
18 dB Amp
+5V
R13
15k
IC2:B
TL082
C17
.1uF
10k (Audio)
Audio Gain
R14
Coax
C18
.001uF
+12v Keyed
on TX
R20
47k
Sidetone Freq Adj. (440hz)
51k
R19
R21
3.9k
R22
1k
Q1
NTE6402
C24
.1uF
R18
15k
C23
.05uF
R17
100k
C25
.001
C20
100pf
R15
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Audio Out
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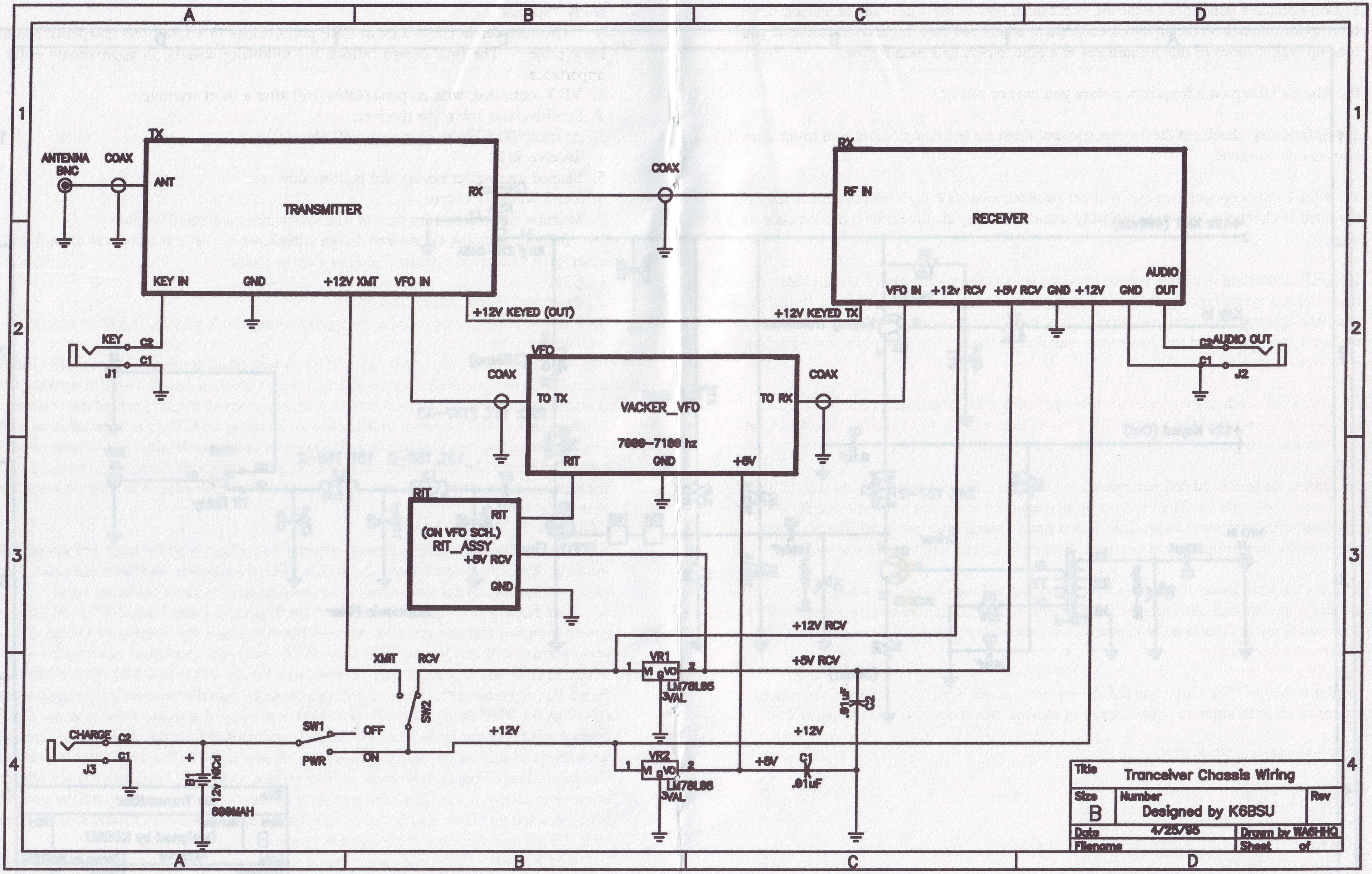
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COAX
TX
ANT
TRANSMITTER
RX
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GND
+12V XMT
VFO IN
+12V KEYED (OUT)
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KEY
J1
COAX
RX
RF IN
RECEIVER
AUDIO OUT
VFO IN
+12V RCV
+5V RCV
GND
+12V
AUDIO OUT
J2
VFO
TO TX
VACKER_VFO
TO RX
7000-7100 hz
RIT
GND
+5V
RIT
(ON VFO SCH.)
RIT_ASSY
+5V RCV
XMIT
RCV
SW2
SW1
OFF
ON
PWR
+12V
CHARGE
J3
B1
12v NICd
600MAH
VR1
LM78L05
3VAL
+12V RCV
+5V RCV
VR2
LM78L05
3VAL
+5V
C1
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.01uF
C2
Title
Tranceiver Chassis Wiring
Size
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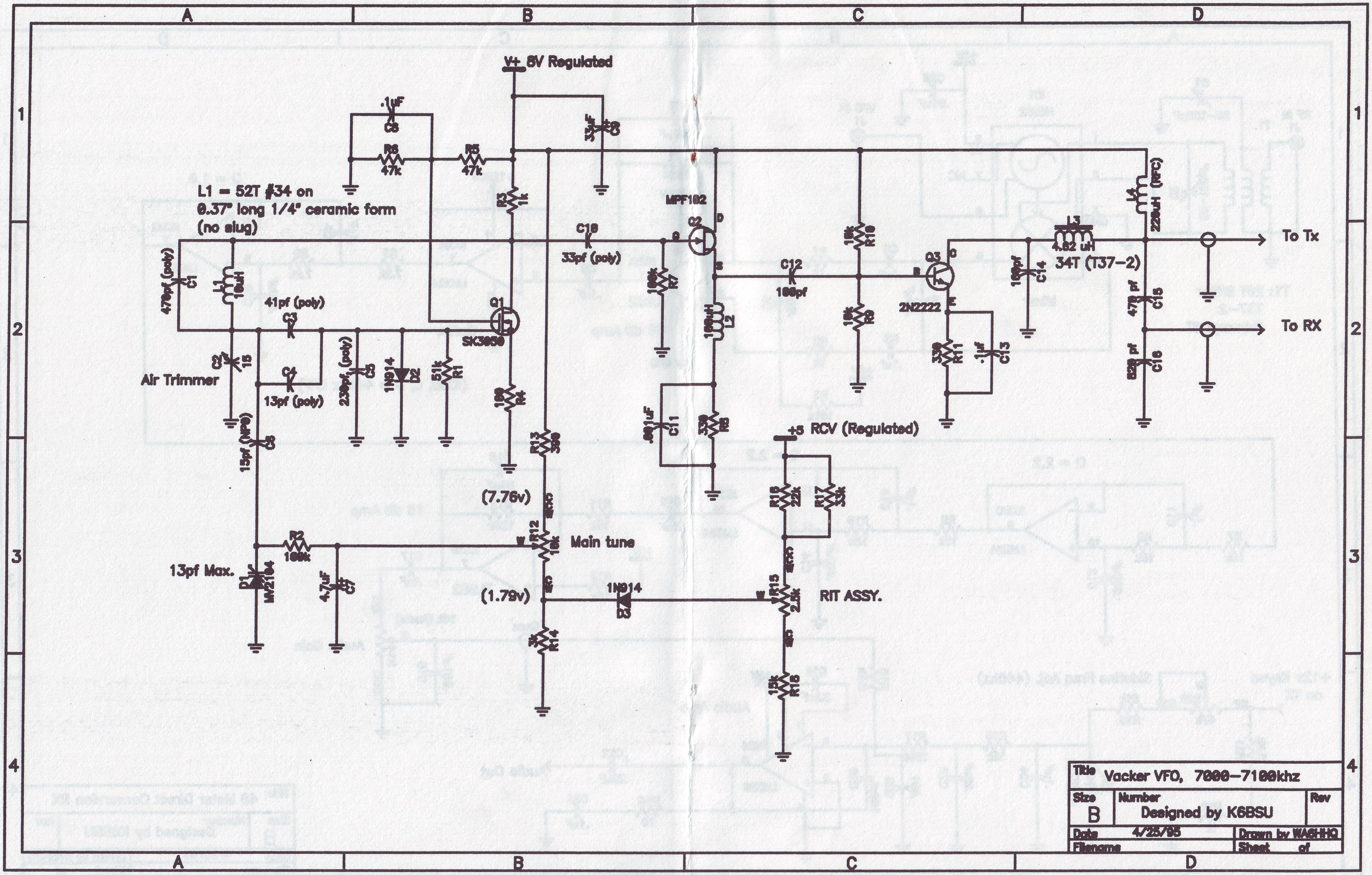
Number
Designed by K6BSU
Rev
Date
4/25/95
Drawn by WA6HHQ
Filename
Sheet
of


V+ 8V Regulated
L1 = 52T #34 on
0.37" long 1/4" ceramic form
(no slug)
C10
33pf (poly)
MPF102
Q2
41pf (poly)
Q1
SK3050
Air Trimmer
13pf (poly)
C12
100pf
Q3
2N2222
L3
4.82 uH
34T (T37-2)
To Tx
To RX
+5 RCV (Regulated)
(7.76v)
Main tune
(1.79v)
1N914
RIT ASSY.
13pf Max.
Title
Vacker VFO, 7000-7100khz
Size
B
Number
Designed by K6BSU
Rev
Date
4/25/95
Drawn by WA6HHQ
Filename
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of

some of my previous home-brew projects, this one started with a list of essential design criteria. The fact that the finished product actually met all my design criteria made it really "Special".

This transceiver packs a lot of QRP performance in a small and inexpensive home-brew project. The final design reflects the following criteria, in approximate order of importance:

1. VFO controlled, with no perceptable drift after a short warmup.
2. Sensitive and low noise receiver.
3. At least 100 KHz bandspread on 40 Meter CW.
4. Receive RIT
5. Shaped transmitter keying and built-in sidetone.
6. 3 to 5 Watts RF output
7. Modular construction for ease of trouble shooting and modification.

Before discussing the desired design criteria, let me list some features often found in other QRP transceivers, which I did not want to include:

1. QSK
2. Receiver RF gain control and AGC.
3. Xtal filter IF strip, air variable tuning capacitors, diode mixers, and other expensive or hard to find parts.

QSK is a feature of virtually all of the 100 Watt transceivers from the Orient. But not many CW operators use it. I make a point never to break in on a station I'm working until it is turned over to me. The station has something to say to me, so I extend the courtesy of listening instead of butting in. AGC action is annoying on CW. It is impossible to adjust the AGC time constant to match the wide range of code speeds, so gaps between words or pauses will allow the AGC to increase receiver gain, along with background noise. So I let the receiver run wide open all the time and use the AF gain control to provide a comfortable audio level.

CIRCUIT DESCRIPTION

The 73 Special contains three subassemblies, which may be built and tested individually. The subassemblies are: the Vackar VFO, the receiver, and the transmitter. Each unit is connectorized for easy removal and modification without soldering wires.

VACKAR VFO: The crown jewel of the 73 special is the Vackar VFO. My experience has shown that this circuit is more stable than either the Colpitts or Clapp. I have experimented with the Vackar VFO since 1978, and I have published two articles on this circuit in QST and CQ magazines. I have built Vackar VFOs at 4 MHz that exhibit less than 5 Hz long term drift. This one drifts a little more than that because of the temperature effects of the VVC tuning diode, but I think it is still superior to any other circuit. The 73 Special VFO operates from 7000 to 7100 KHz and it feeds both the receiver and transmitter without additional frequency conversion. A two stage buffer amplikfier isolates the Vackar oscillator from both receiver and transmitter, so the VFO frequency is not affected by receiver tuning, transmitter keying or antenna tuner effects. A pi output filter removes harmonics and this filter also performs signal splitting to supply the NE602 receive mixer with 200 mv and the transmitter with full power.

RECEIVER: Direct-conversion receivers always seem to get a bum rap. Even I was skeptical until I recently owned a Heath HW-8 QRP rig. I was impressed by its superb weak signal reception and by its sharply tuned bandpass audio filter. Finally, the absence of expensive or hard to align Xtal IF filters made the D-C receiver seem very attractive. The only shortcoming of a D-C receiver is its poor RF selectivity. So if the ham next door fires up on QRO you are out of luck. (I do happen to live next to another ham, but he doesn't operate much).

There is only one tuned circuit in the receiver! Well, it is actually double-tuned for a full 100 KHz coverage on 40 Meters. The popular NE602 double-balanced mixer IC is a good choice as the RF stage/mixer. It is simple, provides about 14 dB conversion gain, and is readily available for about $2. VFO injection should be about 200 mv R.M.S. at the signal frequency of 7000 to 7100 KHz.

The NE602 has a differential output, so maximum gain is realized by using both outputs of the NE602 into 1/2 of a TL082 dual op amp (Radio Shack). Simple R-C filtering permits only audio recovery, while the op amp gives 40 dB of audio gain.

IC3 is an op amp used as a 3-stage low pass audio filter with peaking at 440 Hz. Since the audio filter has nearly DC response, one can zero-beat an incoming signal (with RIT off). Peaking at 440 Hz. in the filter allows signals to "pop" in and out of the audio passband so that signals close close together are easily separated.

The remainder of the audio gain is provided by the other half of op amp IC2, and the LM386 audio power output IC easily drives a speaker with enough volume to let me copy from another room while I'm doing other things.

During Transmit, the entire receiver string is turned off by removing DC power, except that the audio power stage is always on. Then keyed 12V operates a Programmable Unijunction Transistor (PUT) audio oscillator which is coupled to the audio power stage to provide sidetone (also at 440 Hz). Many of the popular home-brew QRP rigs or "kit" rigs do not have sidetone, so that operation with a simple straigt key is difficult without it.

RIT enables zero beat of an incoming signal, thus conserving bandwith on the often crowded 40 Meter band. The RIT is configured so that maximum CCW rotation of the RIT control turns it completely off. Rotating the RIT control CW raises the receive frequency to about 1 KHz higher than the transmit frequency. The RIT is disabled on Transmit, so the transmit frequency then becomes the same as the previous zero beat frequency. No guessing about frequency offset here! It is automatic.

TRANSMITTER: The transmitter uses an inexpensive VMOSFET IRF 510 or IRF 511 output transistor from Radio Shack. DC input power to the stage is adjusted to 4.2 Watts with an RF output of 3 Watts. The VMOSFET is easy to drive, so only a simple Class A buffer stage is required between the VFO and the power amplifier. The Class A buffer is the only keyed stage, but RF leak-through is not detectable. A PNP keying transistor permits independent shaping of the keying waveform. An R-C network at its base terminal gives the desired waveshape, and it will respond to changes in R-C time constant, if different keying characteristics are desired.

The VMOSFET transistor gate has a threshold of +2 to +4 volts. So that at zero bias, only the positive RF peaks of the Class A driver output will cause conduction. This is equivalent to Class C operation. The conduction angle can be increased by providing some external bias to the VMOSFET. R10 does this, and this potentiometer is therefore used to adjust output power.

Various diode antenna switching schemes were tried, but all of them caused attenuation of the received signals. Nothing works quite as well as a good old relay. So this was used, even at the expense of an additional 30 ma of battery current drain.

CONSTRUCTION: The most practical starting point is to find a suitable cabinet and a small enclosure for the VFO. Then the receiver and transmitter circuit boards can be made in any shape that will fit the available space.

PC boards are a lot of extra work, and I can never seem to get them right the first time. So, I always start with single or double sided copper clad board material cut to shape as required. I first make a sketch of parts placement and then transfer all the hole locations to the smooth copper clad board material. Then all holes are drilled, and those which are not to be grounded are run through again with a pad cutter to remove about 3/

32" diameter copper from around the component lead holes.

Next, all components are placed on the drilled board so that the leads exit through the bottom of the board. I use "Zap" CYA instant adhesive to secure all parts. All leads are then cut to about 1/8" and the interconnection is done using 30 ga. Kynar insulated wire wrap wire. Those component leads to be grounded are simply soldered to the copper sheet. This construction technique takes a little extra work with a 25 Watt soldering iron. But it really saves time up front, because virtually no planning is required for parts placement, and no space allocation is needed for P-C traces. This technique also permits wiring changes and component changes without making a big mess of the circuit board.

Each subassembly is connectorized to the chassis wiring harness, and RF connections are made using RCA phono jacks and plugs. Miniature RG174 coax cable works well with these RCA phono plugs.

CALIBRATION: Only a few easy circuit adjustments are required and no special component selection is necessary. A calibrated station receiver or a frequency counter and a VOM are all the test equipment necessary to get the 73 Special on the air.

First, adjust the Vackar VFO to cover the desired 100 KHz portion of the 40 meter band with RIT control turned off (CCW). Turning the RIT potentiometer fully CW should cause the VFO to increase in frequency by about 1 KHz.

The two receiver tuning capacitors are stagger-tuned. Peak one of them about 1/3 the way up from the lower edge of the band, and peak the other one about 2/3 the way up.

Connect a dummy load to the transmitter and prepare to monitor the VMOSFET RF power stage current with a DC ammeter (connecting into the jumper shown on the schematic diagram). Key the transmitter and peak the two trimmer capacitors for maximum PA stage current at mid-band, or stagger them as was done for the receiver for an even power output across the band. R10 is used to set the key-down PA current to about 350 ma. At this point, a wattmeter should indicate about 3 Watts into a 50 ohm load.

The transmitter will easily produce 10 Watts output with a 15 volt power supply and with R10 set for maximum bias. Of course, this would not be be QRP, but 5 Watts output can be obtained with an extra NiCd cell in the battery pack. I chose 3 Watts output for a reasonable operating time from my built-in battery.

PARTS SOURCES

Dan's Small Parts
1935 So. 3rd West #1
Missoula, MT 59801 (ask for 6 page catalog)

1/4" dia. ceramic coil form (Millen)
RG174 coax
RF chokes
NE602AN mixer IC
MV2104 VVC
78L05 and 78L08 voltage regulators
1N5258 Zener diode.
Amidon toroid cores and ferrite beads
mica trim caps, NPO ceramic and poly caps

Radio Shack

IRF510 or IRF511 VMOSFET
2N3053, MPF102, 2N2222, etc.
op amp ICs
fixed resistors & pots
most ceramic capacitors
hardware and wire
RCA phono jacks and plugs
connectors

A Simple Noise Blanker for NE602-Based Receivers

by Wayne Burdick, N6KR
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Belmont, CA 94002
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I just realized—after six months—that I have a very high noise level at my new QTH during the day. I guess I'm spending too much time building radios to notice things like this. Anyway, I was working on a 20M SSB receiver, heard the horrible noise, and decided to do something about it.

What I needed was a noise blanker: a circuit that detects large, short-duration noise spikes and suppresses them before they get to the crystal filter. Every commercial radio has one, but you rarely see one in a home-brew design. The noise blanker I came up with reduces that loud, buzzy line noise that comes from power poles and the like.

I could spend a couple more months refining the circuit, but I decided that it was working well enough that I had to let people with serious noise problems start using it right away. It's sort of like when new medicines are being studied; one group gets a placebo, the other gets the real thing. The group getting the real thing suddenly gets healthier, while the placebo group starts dying off. Out of compassion, I have suspended the study.

This noiseblanker is quite simple and won't work in all cases—just on very repetitive line noise. It won't do anything for atmospheric noise: for that you need "diversity receive," another thing you don't see very often in homebrew rigs!

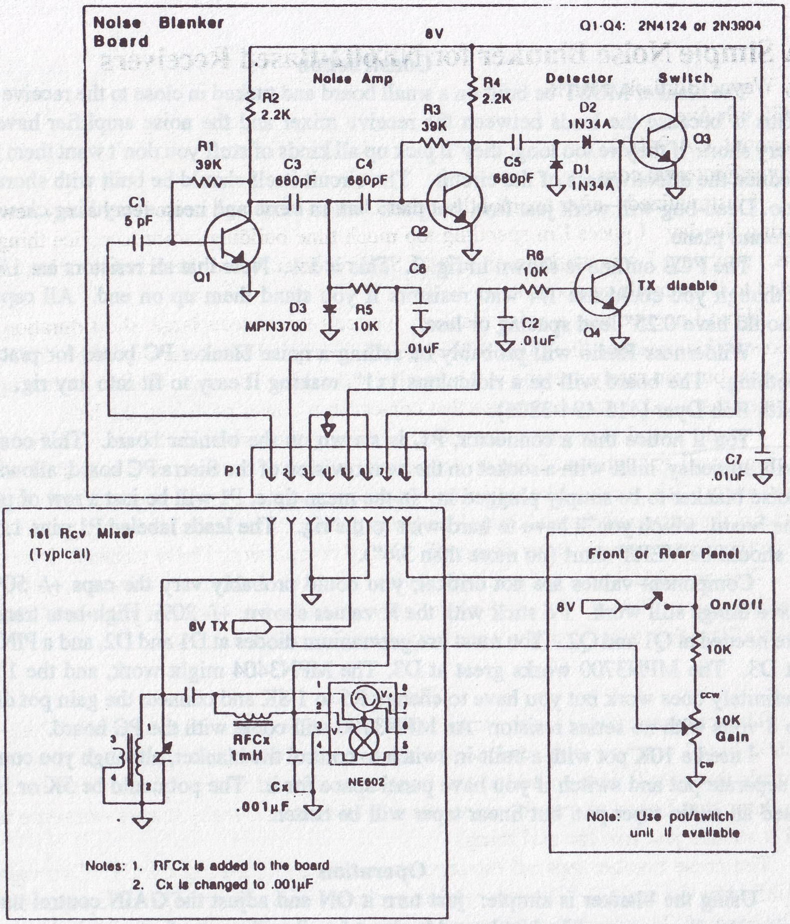
The Circuit

The schematic (fig. 1) is shown in four parts: (1) the noise blanker itself; (2) a typical NE602-based receiver front end, in this case the Sierra's; (3) a small box showing the controls that you'll need to add to the front or rear panel of the rig; and (4) a line noise simulator that I used to test the noise blanker (this circuit really cranks out some noise, and it sounds just like the real thing).

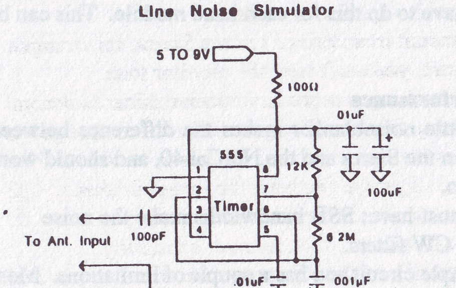
The noise blanker taps off the input tuned circuit of the rig via C1. This signal is amplified by Q1 and Q2. The noise pulses are detected by D1 and D2 and applied directly to the base of Q3, which then shuts off the first receive mixer for a short period to mute each noise pulse. D3 is a PIN diode, and is used to vary the gain of the first amplifier stage by way of the panel-mounted gain control. I used a PIN diode attenuator so that the GAIN control could be located anywhere. Q4 disables Q3 during transmit, which is important if the rig uses direct transmit monitoring. On the Sierra, for example, if you don't have Q4, then when you transmit, you can't hear the monitor tone.

Notice that there are two very important changes to the first receive mixer to accommodate the noise blanker. First, the bypass cap from pin 2 to ground has been changed to .001 rather than the usual .01 or .05. This is necessary because Q3 has to be able to kick in very quickly to mute the noise pulse. The larger the cap here, the longer it takes for Q3 to act on the pulse, and once the pulse gets past the first receive mixer you can't do anything with it. Noise city. The smaller cap won't reduce receiver sensitivity.

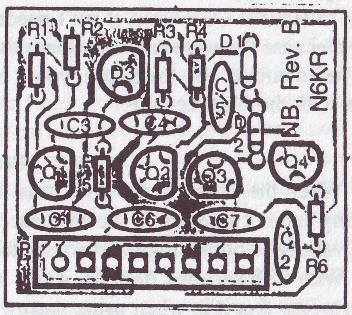
The second important change is the addition of the RF choke from pin 1 to pin 2 of the '602. This is needed to make sure that the mute signal is "common-mode," thatis, it must appear on both differential inputs to the mixer so that it gets canceled and doesn't appear at the mixer output. If your receiver circuit has a complete D-C path from pin 1 to pin 2 already (usually via a toroid core), you can eliminate the RF choke.



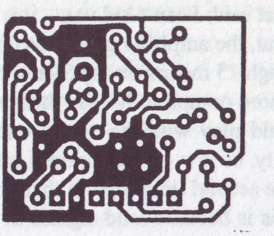
Noise Blanker Board
Q1-Q4: 2N4124 or 2N3904
8V
Noise Amp
Detector
Switch
R1 39K
R2 2.2K
R3 39K
R4 2.2K
C1 5 pF
C3 680pF
C4 680pF
C5 680pF
D2 1N34A
D1 1N34A
Q1
Q2
Q3
Q4
C6
D3 MPN3700
R5 10K
.01uF
R6 10K
C2 .01uF
TX disable
C7 .01uF
P1
1st Rcv Mixer (Typical)
8V TX
RFCx 1mH
Cx .001µF
NE602
Front or Rear Panel
8V
On/Off
10K
ccw
10K Gain
cw
Note: Use pot/switch unit if available
Notes: 1. RFCx is added to the board
2. Cx is changed to .001µF



Line Noise Simulator
5 TO 9V
100Ω
.01uF
100uF
555 Timer
12K
6.2M
100pF
To Ant. Input
.01uF
.001µF



R1
R2
R3
R4
D1
D3
C5
D2
C3
C4
Q1
Q2
Q3
Q4
C1
C6
C7
C2
R6
NB, Rev B
N6KR



Construction

The blanker MUST be built on a small board and tucked in close to the receive mixer. This is because the leads between the receive mixer and the noise amplifier have to be very short: if they're too long, they'll pick up all kinds of stuff you don't want them to, and reduce the effectiveness of the circuit. The circuit itself should be built with short leads, too. Dead-bug will work just fine, but pack 'em in close and keep everything close to the ground plane.

The PCB outline is shown in fig. 2. This is 1:1. Note that all resistors are 1/8 watt, although you could use 1/4 watt resistors if you stand them up on end. All capacitors should have 0.25" lead spacing or less.

Wilderness Radio will probably be selling a noise blanker PC board for practically nothing. The board will be a ridiculous 1x1", making it easy to fit into any rig. Check with Bob Dyer (415-494-3806).

You'll notice that a connector, P1, is shown on the blanker board. This connector will, someday, mate with a socket on the next revision of the Sierra PC board, allowing the noise blanker to be simply plugged in. In the mean time, P1 will be just a row of pads on the board, which you'll have to hard-wire to the rig. The leads labeled P1 pins 1, 3, and 7 should be VERY short (no more than 3/4").

Component values are not critical; you could probably vary the caps +/- 50% and have things still work. I'd stick with the R values shown, +/- 20%. High-beta transistors are needed at Q1 and Q2. You must use germanium diodes at D1 and D2, and a PIN diode at D3. The MPN3700 works great at D3. The MPN3404 might work, and the 1N4007 definitely does work but you have to change R5 to 1.8K and connect the gain pot directly to 8 volts with no series resistor. An MPN3700 will come with the PC board.

I used a 10K pot with a built-in switch to control the blanker, although you could use a separate pot and switch if you have panel space for it. The pot could be 5K or 10K. I used an audio taper pot, but linear taper will be better.

Operation

Using the blanker is simple: just turn it ON and adjust the GAIN control until the noise just disappears. The blanker adds about 6 to 7 milliamps of current drain, so you'll want to leave it OFF when it isn't needed.

Because the noise amplifier loads the input tuned circuit slightly, you'll have to repeak that tuned circuit. On the Sierra, you'll have to do this for each band module. This can be done with the blanker OFF.

Performance

When the power poles sing, this little noiseblanker makes the difference between hearing and not hearing. It works great on the Sierra and the NorCal 40, and should work on a variety of other simple receivers, too.

With SSB receiver designs, it is a must-have; SSB bandwidths make the noise seem worse that it is when using narrow CW filters.

That said, I can't kid you: it is a simple circuit and has a couple of limitations. Most important, the amplifier gain rolls off a bit as the frequency goes up. The gain is sufficient up through 15 meters on my Sierra, but I just bet someone is going to find out that the amp needs more oomph to handle their particular receiver and noise situation. Said individuals should play with the circuit and improve the gain. But not at the cost of stability, simplicity, or low current drain, I hope.

The second limitation is that on 40 meters and below the GAIN setting can be critical. This is because loud signals in the passband of the receiver, such as A.M. broadcast

stations or the guy down the street, can sometimes be nearly as loud as the noise pulses you're trying to mask.

If you turn the gain up too high, you'll find out exactly what I mean: the noise amplifier will become saturated with these large signals, Q3 will pass the signals on to the NE602, and you'll hear an assortment of garbage signals coming through your receiver. Don't do this! Back down the GAIN control if you start hearing new stuff that isn't supposed to be there.

By the way, even commercial noise blankers suffer from this to some degree, but they don't usually admit it. I hope this project helps you work the weak ones!
72, Wayne, N6KR

The Pixie 2: An Update

by Dave Joseph, WA6BOY
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San Jose, CA 95124

The Pixie 2 first appeared in the third issue of the NorCal QRPp Journal. Doug, KI6DS, recently asked me if I would write another article updating it, since the membership has grown so much and many of the new members have not seen the article.

The circuit first appeared in an issue of the G-QRP Club's "Sprat" and the first issue of QRPp. It was designed by RV3GM. I've modified the circuit's output and audio amplifier.

Although most of the QRP circuits today have evolved into using superhet receivers, a diversion back to direct conversion is not unusual... since QRP, after all, is a unique part of amateur radio and simplicity is certainly a part of it.

The Pixie 2 is a tiny rig, with a standard two transistor transmitter. It's a Colpitts oscillator, left running, and a keyed power amplifier. There is no external mixer used to feed the audio amplifier. Instead, the mixing is done at the final amplifier itself with the resulting audio taken off the emitter.

As you look at the audio amplifier you will certainly notice D1. It is an unorthodox approach, but it works. The diode can be left out but it helped to keep down the "crashes" during keying by shutting down the 386 chip. I'm no wizard at this... I just tried it and it seemed to work. I'm sure there's lots of you that have much better ways.

There's no RIT, a simple switch and cap in parallel, between the crystal will work as an offset though. You'll lose QSK but, here again lies the call for enhancement. The whole idea here was to make a tiny rig that worked, with LOTS of room for improvements, using a minimumb of parts.

Contacts spanning hundreds of miles are routine with this rig on 80 meters. Band changing is simply a matter of pi-network and crystal changing. If you build one, I'm sure you'll have fun with it. Construction can be by any method, perfboard, "ugly" and pc board. Complete parts kits are available for those of you who are interested. (1)
Construction:

You will need a low wattage soldering iron with a small tip, some rosin core solder, solder wick (for removing parts when you make mistakes), small wire cutters, needle nose pliers plus any additional tools you may wish to use. PLEASE PROTECT YOUR EYES WHILE CUTTING LEADS AND SOLDERING COMPONENTS! WARN OTHERS CLOSE BY.

Since all the components, except for U1, are mounted vertically, it's best to start at one end of the board and work to the other. No particular starting point is necessary. Take your time, enjoy the assembly. Your transceiver will be finished sooner than you think.

There's no coils to wind, no alignment either. This is definitely a FUN project.

Note: There is one component that will be mounted on the underside of the board if you build it with the pc board. This is the 1K resistor in the kit. Refer to the drawing on the parts layout for it's location.

Before you get started, note the following parts MUST be installed only one way: The 10uF electrolytic caps, D1 - the diode, the two transistors, and finally, U1 the audio amp chip. Make sure you mount these components exactly as the parts layout shows you to. If you mount any of these the wrong way, your transceiver will not work and you'll probably destroy the part. The only exception is C11, but it is best to install it as shown.

Mount all of the parts, again, starting from one end of the board. Carefully check to see you have the correct part before installing it in it's location. Refer to the parts layout drawing. Double check before inserting the part. This will avoid problems in getting your rig on the air. Install the 1K resistor last. This resistor is R5, and is tack soldered between the 9 Volt pad and the POSITIVE terminal of C10. Dress the leads of this resistor so that they "fly" off the board. You might want to put some sleeving over the leads, or, some electrical tape underneath to be sure they don't short to the board. R5 is shown in dotted lines on the layout.

You will need the following additional items (not supplied in the kit):

2 - RCA jacks, or 3.5 mm jacks. (For Key and Antenna).

1 - 3.5 mono or stereo jack, depending on your headphones.

1 - short piece of RG- 174 For Antenna Connection.

1 - Crystal socket or pair of mini-alligator clips.

This transceiver does not have RIT (receiver offset). It is possible to work other stations, if you are close to their frequency. Even if the received signal is off frequency, give them a call. A simple RIT circuit using a mini-toggle switch and capacitor, hooked up in parallel, and placed in the line between the crystal and ground works well. You won't have full break-in, but it works.

Remember, all that's needed to change bands on this rig is change L3 and the crystal, and you have a rig for another band!! You can use "walkman" style headphones, with a mono adapter. There is even enough audio power to drive a speaker. It's not very loud but you can hear easily in a quiet room ... neat!

This rig has been packaged in a 35 mm film can, a Tic-Tac box, Sucrets box (easy), just to name a few. The enclosure is up to you. One just big enough to hold the rig and the 9 Volt battery will give you a tiny self contained unit.

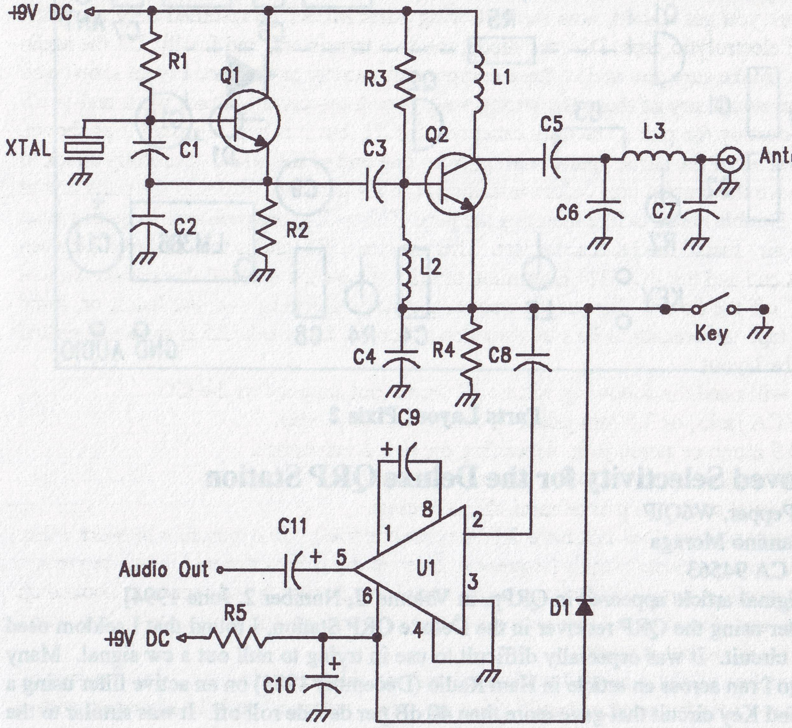
Many contacts using a simple end fed quarter wave wire, worked against a good ground, have been made with this rig. Most of them have been over hundreds of miles away. The transmit signal is very clean, with no key clicks since the oscillator is always running. Just listen to it! Power output is in the 200 to 300 milliwatt range. You'll be amazed what happens at this power level with a decent antenna.

This is a "bare-bones" rig. Use your ingenuity or, enlist the help of an experienced ham to help enhance the operation of your rig. Refer to QRP articles, like those in QRPp, SPRAT, ARCI and others devoted to QRP operating. If you're not an experienced builder, this kit was designed especially for you. If you've been building circuits,, it's hoped you'll have fun with this little rig and/or help a beginner get started in the wonderful world of QRP.

If you come up with mods for the rig, publish them in QRP. Send Doug reports on your experience building and operating it. There are surplus crystals available for less than a dollar for 3.579MHz and 3.686MHz. For that price, buy one, solder it in and don't worry about changing frequencies.

Enjoy, 72, Dave, WA6BOY

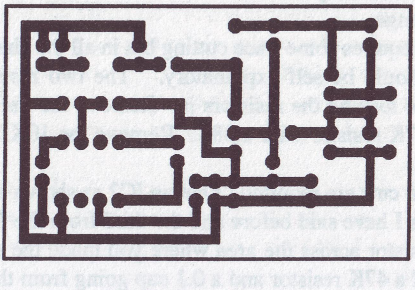
(1) Parts kits for the Pixie 2 are available from: HSC Electronics, 3500 Ryder St., Santa Clara, CA 95051. The cost is $9.95 + $2.00 shipping and handling for the pc board and all board mounted components except the crytal. Chokes will be provided for both 40 and 80 meters. Phone 1-800-4HALTED.



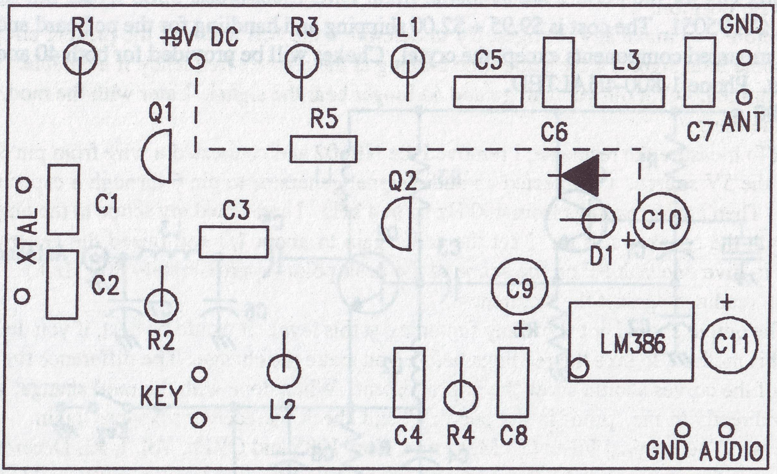
Parts List

C1,2	100pF	C9,10,11	10uF/25V Elec	R1	47K
C3	82pF	D1	1N914	R2	1.5K
C4	.05uF	L1	15 - 22 uH Choke	R3	33K
C5	.01uF	L2	100 uH Choke	R4	10K
C6,7	820pF	L3	40M - 1uH	R5	1K
C8	0.1uF		80M - 2.2uH	U1	LM386

Fig. 1 Pixie 2 Schematic



PC Board Foil Side



Parts Layout Pixie 2

Improved Selectivity for the Deluxe QRP Station

by Jim Pepper, W6QIF
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Orinda, CA 94563

[The original article appeared in QRPp, in Volume II, Number 2, June 1994]

After using the QRP receiver in the Deluxe QRP Station, I found that I seldom used the null circuit. It was especially difficult to use in trying to null out a cw signal. Many years ago I ran across an article in Ham Radio (December 1981) on an active filter using a Sallan-and Key circuit that gave more than 40 dB per decade roll off. It was similar to the null circuit so I decided to convert over to this circuit to see if I could improve the selectivity. One of the reasons people don't like the Direct Conversion receiver is because they claim it doesn't have the selectivity of a superhet especially one with a crystal filter. I wanted to see if I could overcome this draw back.

Before making the mod, I used a SPICE program by GEOBAN to get the response I wanted. See the curve in figure 1. I also measured the response of the receiver with an audio oscillator and scope before and after the mod.* They compared quite favorably with these curves. I also asked John Pratt (N1UA) to make the change and he reported similar results. In checking the receiver before the change, he could hear a signal about 4.5kHz away from the peak and after only 1 kHz. I also found the same on my receiver. It definitely is worth the change.

To make the change requires some trace cutting but in all the change is not that great. The attached drawings should be self explanatory. The two resistors by IC3 can be jumpered on the trace side leaving the resistors in. Remove the 1uF tantalum capacitor. Next to IC2 replace the 47K resistor with a 68K. Remove the 10K and replace it with a 0.1uF capacitor.

On the trace side, two cuts are required. One on IC2 as shown and one on IC3. IC3 has three jumpers. Two as I have said before and the third from the 510pF cap to pins 6/7. On IC2, add a 12K resistor across the area where you made the cut. And then add a series circuit composed of a 47K resistor and a 0.1 cap going from the two traces shown.

That is it. The null control is no longer effective but it remains in. Set it to the full clockwise position.

Before you make any changes, try to determine the bad width of the present circuit. Tune some loud signals a the same time looking at the counter frequency if available. Try to determine how far out you can go and no longer hear the signal. Later with the mod, do the same thing.

*(To measure the response, I removed the NE602 and connected a wire from pin 5 of IC2 to the 5V source. I connected an audio signal generator to pin 6 through a capacitor. (.1uF). Then I took readings from 400 Hz up to 4 kHz. I connected my scope to the output jack with the speaker still in. I set the audio gain to about 1/3 and raised the generator output to give one volt PP on the scope at the peak point (approximately 800 Hz.).) Plot the readings against the frequency.

The output should not show any flattening at this level. It would be best, if you desire to go this method, to take the readings before you make the change. The difference tin the shape of the curves should show the improvement. When done with the mod change, you can go directly to the "proof in the pudding" and check thereceiver response again.

Note: The magical Filter (73 Magazine, Nov. 1983 and QRPp, Vol. I, #3, December 1993) uses the same circuit. It could also be modified to give similar results. 72, Jim Pepper, W6QIF

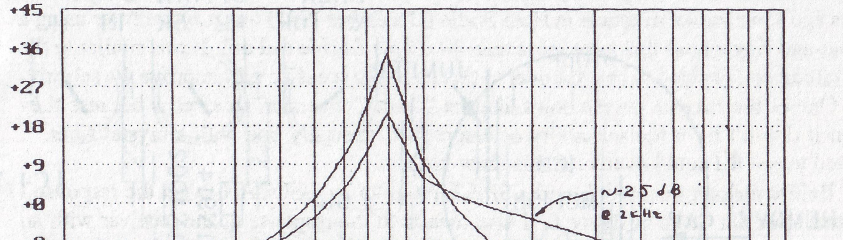

Figure 1

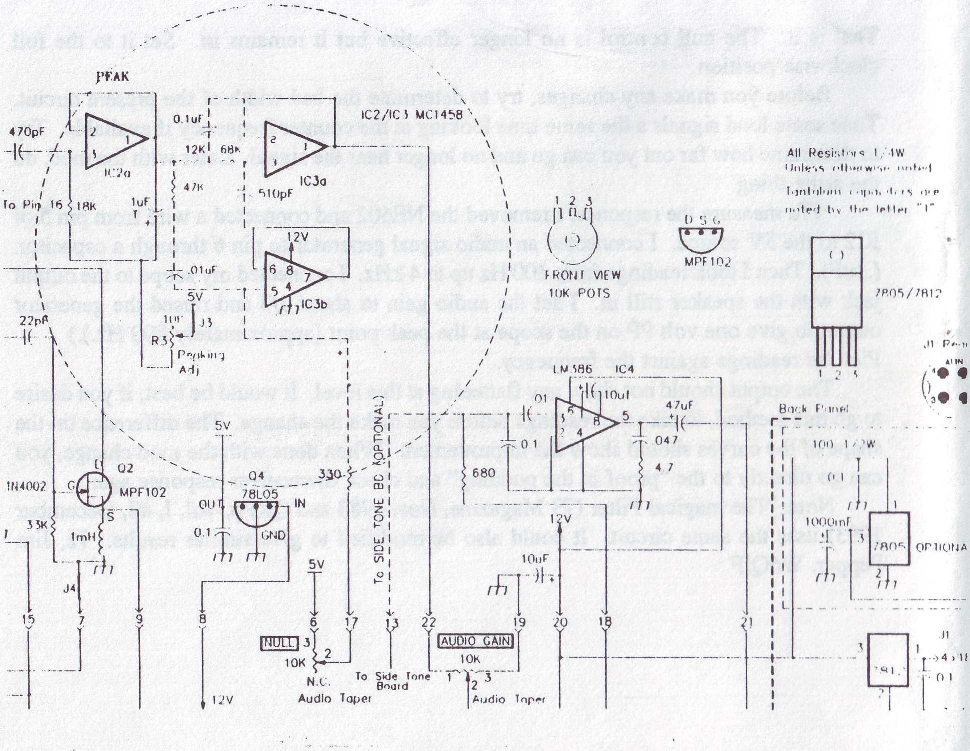

Figure 2

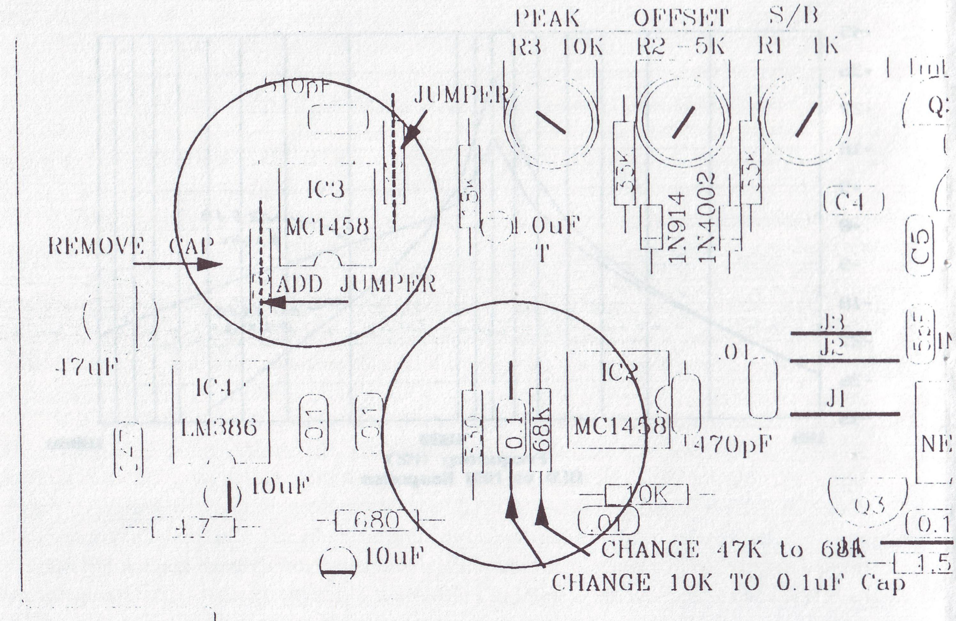

Figure 3

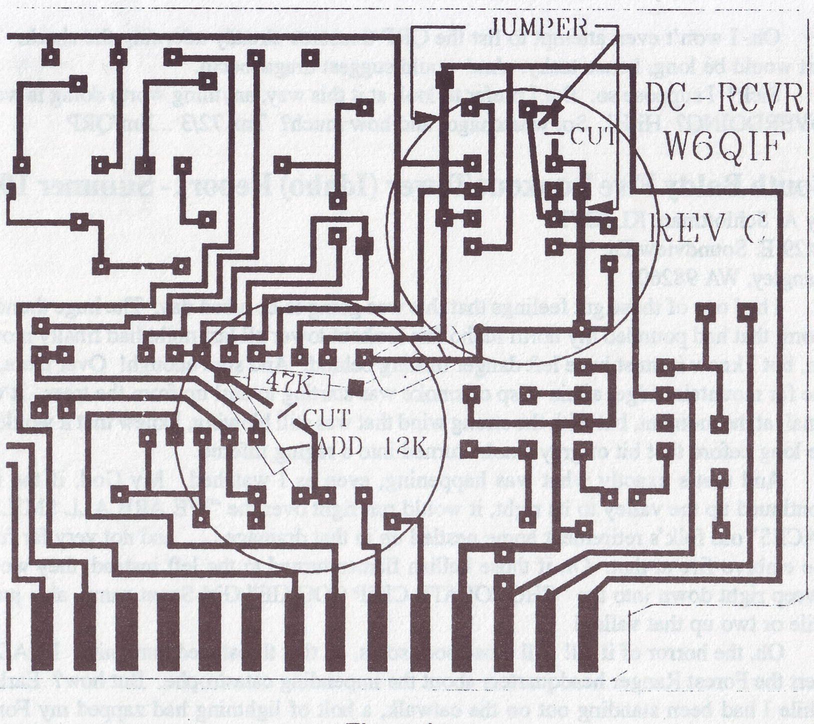

Figure 4

Warning: Notorious QRP Pack Rat at Large

by Jim Cates, WA6GER
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Was it Dr. Freud or mike Royko's Dr. I.M. Cookie who explained it to me this way: "Jim, you are a pack rat because you grew up during the THE GREAT DEPRESSION, and being deprived of toys during those formative years, it is only natural that now in your SECOND childhood, you have become what you are today, a hopeless pack rat." I protested that saving paper clips and rubber bands might be a minor quirk, but hardly qualifies as apersonality disorder. "Oh yeah?" exclaimed the good doctor, "who else would have an attic full of empty beer cans?"

Alas, alas, now exposed, I may as well confess to being an accumulator of a lot of things, but especially QRP stuff. I think this limiting is a step in the right direction, and may indicate some progress in coping with this pack rat malady. Oh, yes, I am into key paddles and wattmeters also, but that is a tale for another time.

Ok, so much for the problem; now for the solution. If I am to become the Hunt brothers of the QRP World, then to corner the markiet, I simply must have your help. Upon what dusty shelves lie these QRP goodies I seek? Including rigs, kits, accessories, books, magazines? You name it.

So what if I squander the family fortune in this madness? Can't cost any more than psychotherapy. and besides, I not only enjoy owning and fondly gazing at the QRP stuff I have managed to accumulate so far, but I also use it. I like to rotate rigs; it's like getting a new toy. and the books and magazines, oh what a poor memory I; can read them every month and each time like a new issue.

Oh, I won't even attempt to list the QRP treasures already adorning the shack. The list would be long, hence tacky. And would suggest bragadoccio.

Sick? I suppose so. But I prefer to look at it this way, anything worth doing is worth OVERDOING? Hi Hi. So, whatchagot and how much? Tnx 72/3 .. Jim/QRP

South Baldy Fire Lookout Tower (Idaho) Report - Summer 1994

by Al Schlottman, KL7CVP
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I had one of those gut feelings that this was going to be a bad day. The huge thunderstorm that had pounded my north Idaho fire lookout tower all last night had finally moved on, but I knew it must have left danger lurking behind. And sure enough! Over there, on the far mountain ridge, a thin wisp of smoke was starting to curl up from the trees. It was small at the moment, but with the strong wind that was still blowing, I knew that it wouldn't be long before that bit of gray smoke turned into a raging inferno.

And that's exactly what was happening, even as I watched. My God, if the fire continued up the valley to its right, it would run right over the "WE ARE ALL SMILEY FACES" old folk's retirement home nestled up in that drainage . . . and not very far from the embryo fire at that. Or, if those hellish flames turned to the left instead, they would sweep right down into the "CHOCOLATE CHIP COOKIE" Girl Scout camp, also just a mile or two up that valley!

Oh, the horror of it all! All those poor souls, all that threatened humanity! I HAD to alert the Forest Ranger headquarters about the impending catastrophe. But how? Earlier, while I had been standing out on the catwalk, a bolt of lightning had zapped my Forest Service handheld radio clean out of my hand (naw, it didn't hurt.... only a slight tingling sensation), but the rig had been destroyed by its 80-foot fall to the rocks below. Thus I had no radio, no vehicle, and the next pack train wasn't due to come up for two months. I was totally without communications.

But, wait! There was my ever reliable NorCal 40 QRP rig just sitting there on the table. Swiftly I disconnected my wife's hair curler and waffle iron from my battery pack power supply, hooked up the NorCal, and turned it on. But . . . the band was stone cold dead! Not a signal to be heard anywhere across the rig's vast tuning range. But, hold on! There was one faint signal, a VK7 in Tasmania calling CQ. Three times I gave him a call but got no response (this was unheard of with my NorCal!). But then, after tweaking the antenna tuner a bit, I tried one more call and finally had the VK7 hooked! In frantic haste I explained the situation to him. (Luckily, I had majored in advanced Tasmanian while in grammar school). Minutes later the fellow was on the overseas telephone calling the White House, who called the Department of Agriculture, who called the U.S. forest Service, who called our Idaho Ranger station to report the raging fire that, unknown to them, was roaring across the high Idaho forests, soon to claim possibly hundreds of unsuspecting, innocent victims in its path.

But no!! We were in time! It seemed like only scant minutes after my frantic call to the Tasmanian when dozens of smoke jumpers rained down out of the sky, tanker planes started dropping hundreds of gallons of fire retardant on the worst of the flames, and ground fire fighters attacked the fire on all sides with bulldozers, shovels, and MRE's. And not long after that, the Chief Ranger came racing up the rough trail to the lookout tower to congratulate us and my NorCal 40 on a job well done.

Well, maybe that 's not EXACTLY the way it happened... except perhaps in my wild imagination or daydreams. Nevertheless, the old NorCal 40 certainly did help to keep me

in contact with the outside world down below, and it enabled me to make lots of great contacts from our lonesome tower high up in the mountains. (Having an antenna up at 6,000 feetprobably also helped?). In fact, I was even lucky enough to have a short QSO with a fellow by the name of Jim something or other. As I remember, his call was something like WA6GER. That particular QSO stuck in my mind, because the fellow made the far-fetched claim that he too had a nodding acquaintance with the NorCal 40! 72, Al, KL7CVP

Double-Tuned Tower Radiator

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Brian L. Wermager, K0EOU, urged me to report on my success in adapting his broadband, 80-meter-antenna design to a short tower and to publish my analysis of how it works (see his original article in April, 1986 QST and in recent ARRL Antenna Books). My version uses a 28-foot tower made of Rohn-25 sections with the following antennas mounted on a 13-foot-mast extension (2" OD steel pipe):

1) 2-meter Ringo on top of the mast (41-foot level).
2) 6-meter 5-element Cushcraft Yagi at the 39-foot level.
3) 2-meter 11-element Lunar Yagi at the 36-foot level.
4) Two stacked 432 MHz 16-element KLM Yagis centered at 33 feet.
5) A KLM KT-34A tribander at 30 feet.

My slanting top wire is connected at the 26-foot level and is 106 feet long. It is bent back toward the tower at the 8-foot level and continues horizontally for 40 feet 9 inches. I feed a single wire at the 8-foot level on the tower. This wire is 59 feet 11 inches long and is spaced 18 feet from the bend in the top wire at the far end. At the tower end the support point for the horizontal portion of the top wire is spaced 53 inches from the driven wire by means of a yardarm (to reduce capacitance between wires).

My analysis of the system follows:

1) The top wire, combined with the tower and Yagis, produces 3/4-wave resonance. The length is foreshortened by the capacitance-to-ground of the yagis on the mast. In my case the capacitance shortens the overall length by about 55 feet. The wire forces the tower to carry a heavy, nearly-constant current to ground, producing low-angle radiation. The current in the tower is that which occurs in the first 1/8-wavelength (or so) of a grounded monopole— essentially constant.

2) 8 feet of the tower, combined with the driven wire, produces 1/4-wave resonance.

3) There is an 8-foot piece of tower common to both resonant circuits. This provides some inductive mutual coupling. The capacitance between the wires, especially at the ends, produces more coupling because the ends of the wires are 180 degrees out of phase (opposite polarity). So the system really is a double-tuned circuit. This explains the excellent bandwidth, the shape of the SWR curve, and helps one to know what to prune.

4) Pruning and installation effects:

Parameter	Major Effect	Minor Effect
Feed height on tower.	Match.	Coupling (hump height at center response).
Spacing of wires at far end.	Coupling. (hump height)	Response at band edges.

Length of top wire.	Response at 3.5	Overall match.
Length of driven wire.	Response at 4.0	Overall match.
Tower height and what's on top.	Length of top wire.	Feed point.
Wire height above ground.	Resonant frequency. (lower if lower wire)	Driving impedance. (lower if lower wire)

The double-humped response of coupled, tuned circuits is inverted when you look at the SWR curve. So, one sees double dips with a hump in the center. The higher the coupling, the higher the hump. For background information on double-tuned circuits see Terman, Electronic and Radio Engineering, McGraw-Hill, 1955, Page 64, or Bowick, RF Circuit Design, Howard W. Sams, 1982, Page 37.

The reason I have so much spacing at the far ends is that the bent-back wire presents about double the area to the driven wire, hence double the capacitance. To bring this down I needed double the spacing.

Notice that the SWR is a bit high at the band edges. I think a second driven wire, as K0EOU has used, double-tunes the response of the quarter-wave portion, resulting in a triple-tuned system with greater bandwidth. I never operate at the band edges and I don't have room for another driven wire, which would have to be on the far side of the single wire in order to minimize the capacitance to the top wire.

The tower does most of the radiating. The currents in the wires largely cancel each other. So, most of the radiation is vertical. I use only three 8-foot ground rods at the bottom of the tower for grounding.

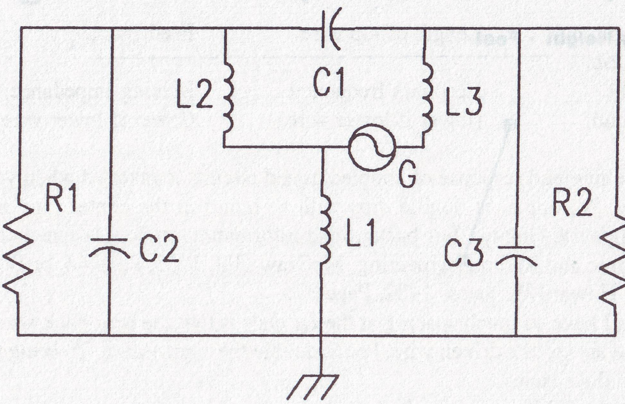
Many variations are possible. 160-meters on a 55-foot tower should work, as well as 40-meters on a short tower. Either wire can be bent in any reasonable configuration so long as each is resonant. The key is to provide the correct coupling capacitance between wires. The equivalent circuit is helpful to visualize coupling elements.

The plot of top-wire length vs tower height provides a good starting length. It assumes at least a tri-band Yagi on top of the tower for capacitance to ground. It also assumes that the quarter-wave, driven wire is resonant and is in place. Because of the capacitive loading of the tri-bander the top wire is not very frequency-sensitive to pruning. The opposite is true of the driven wire. 12-inches change in length of the driven wire makes about 75kHz change at 75 meters. Change the top wire more.

If you have a tall tower (50-75 feet) I recommend you build the triple-tuned K0EOU design. If your tower is short, or you can't accommodate two widely-spaced driven wires, my double-tuned version will still give you very-good band coverage. Either way, the pruning and installation effects are the same.

This antenna is an excellent performer. It blankets all states with a strong signal. I call it my "Double-Tuned Tower Radiator".

W6EMD Equivalent Lumped-Element Schematic



R1 = Radiation resistance of 3/4 wave circuit.
R2 = Radiation resistance of 1/4 wave circuit.
C1 = Coupling capacitance between wires at far ends.
L1 = Coupling inductance of common portion of tower.
C2 L2 = Remainder of 3/4 wave circuit.
C3 L3 = Remainder of1/4 wave circuit.
G = Generator (feed point)

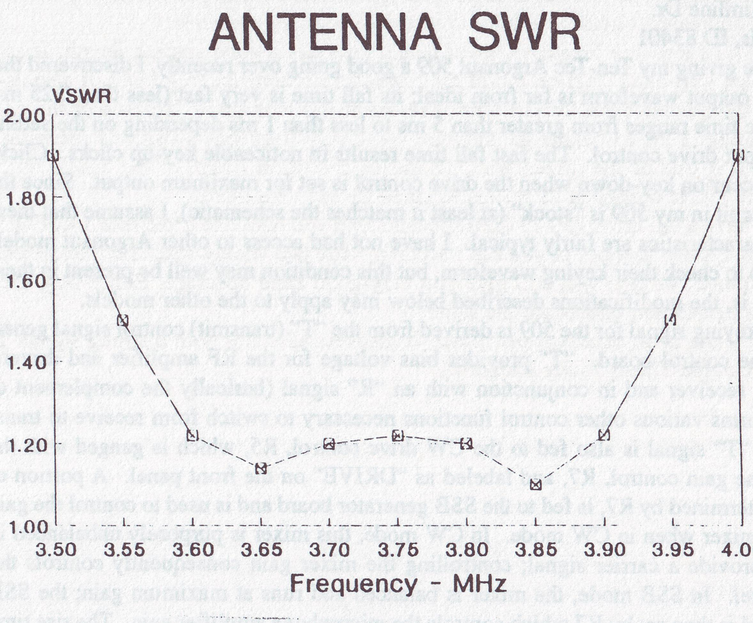


Figure 2

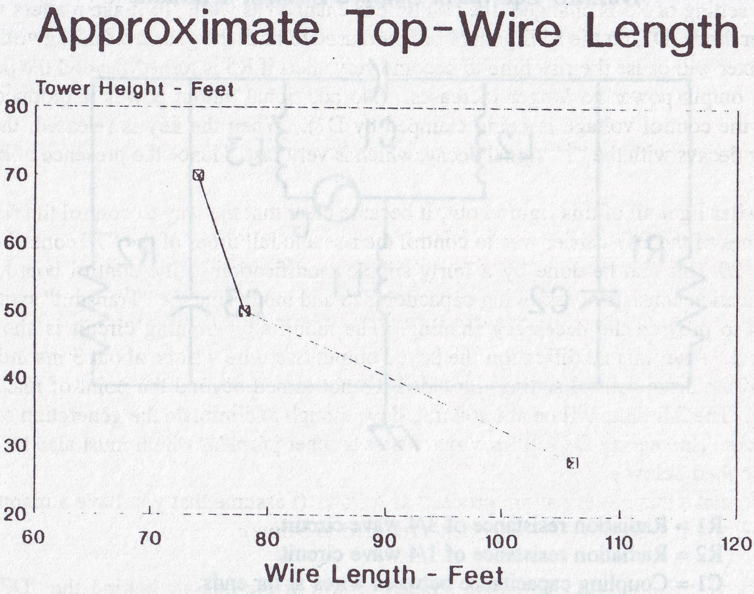


Figure 3

Cleaner Keying for the Ten-Tec 509

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While giving my Ten-Tec Argonaut 509 a good going over recently, I discovered that the keyed output waveform is far from ideal; its fall time is very fast (less than 0.25 ms) and its rise time ranges from greater than 5 ms to less than 1 ms depending on the setting of the output drive control. The fast fall time results in noticeable key-up clicks. Clicks can also occur on key-down when the drive control is set for maximum output. Since the keying circuit in my 509 is "stock" (at least it matches the schematic), I assume that these keying characteristics are fairly typical. I have not had access to other Argonaut models (505, 515) to check their keying waveform, but this condition may well be present in them also. If it is, the modifications described below may apply to the other models.

The keying signal for the 509 is derived from the "T" (transmit) control signal generated on the control board. "T" provides bias voltage for the RF amplifier and drivers, mutes the receiver and in conjunction with an "R" signal (basically the complement of "T") performs various other control functions necessary to switch from receive to transmit. The "T" signal is also fed to the CW drive control, R5, which is ganged with the microphone gain control, R7, and labeled as "DRIVE" on the front panel. A portion of "T", as determined by R7, is fed to the SSB generator board and is used to control the gain of the IF mixer when in CW mode. In CW mode, this mixer is purposely unbalanced in order to provide a carrier signal; controlling the mixer gain consequently controls the carrier level. In SSB mode, the mixer is balanced and runs at maximum gain; the SSB signal level is then set by R7 which controls the microphone amplifier gain. The rise time of the CW signal so generated is determined by a 0.22 capacitor (C18) and R5; however,

as the setting of R5 is changed, the rise time is changed as well. To make matters worse, a zener diode, D1, on the SSB generator board used to limit the gain controlling voltage to the mixer will cause the rise time to become very short if R5 is turned beyond the point at which output power no longer increases. (No additional output power is produced because the control voltage is being clamped by D1). When the key is released, the CW carrier decays with the "T" signal decay, which is very fast. Hence the presence of key-up clicks.

After I got all of this figured out, It became clear that the way to control the rise and fall times of the CW carrier was to control the rise and fall times of the "T" control signal itself.=20 This can be done by a fairly simple modification to the control board. The modification consists of removing capacitor C18 and modifying the "Transmit" switching circuit to provide the necessary shaping. The modified switching circuit is shown in Figure 1. After this modification the keyed output rise time will be about 3 ms independent of the drive control setting, provided it's not turned beyond the point of maximum output. The fall time will be about 2 ms, slow enough to eliminate the generation of key-up clicks. (Increasing the fall time aggravates another problem which must also be fixed, as described below.)

To make this modification, proceed as follows (I assume that you have a manual for the 509; use it to locate the components referred to below):

1. Remove the control board; it is located on top of the chassis behind the "DRIVE" control.
2. Remove C18. This capacitor is mounted under the drive control (R5/R7) and is ratherinaccessible. You may be able to clip one end free and push it back out of the way. Otherwise you will have to remove the front panel and the drive control to reach it.
3. Remove R1 from the control board; use solder-wick and try to get it out in one piece.
4. The next step is to drill mounting holes in the control board to re-mount R1 and to mount the shaping capacitor (Cx in Figure 1). Use a No. 60 drill (0.040 in.) and carefully drill holes as follows (see Fig. 2):

Near the collector of Q1 and another into the +12V trace so that R1 can be re-mounted directly adjacent to R2.

Into the ground trace and just in front of R5; Cx will be mounted using this hole and the original hole connecting R1 to the bases of Q2 and Q3. Position the new hole so that Cx will fit between Q1 and Q2. (A small molded tantalum is recommended; a small radial lead tantalum or electrolytic can also be used).

5. Using a small sharp knife (eXacto, etc.), carefully remove a section of the printed circuit trace connecting the collector of Q1 and the base of Q2.
6. Solder a 1/4 (or 1/8) Watt 3.3K resistor and 1N914 (or 1N4148, etc.) diode on the bottom (trace side) of the control board between the collector of Q1 and the base of Q2. (The cathode end of the diode connects to the base of Q2). There is not much room for these components after the board is remounted due to wiring under the board, so position them as close to the board as possible being sure that their leads do not contact other PC traces.
7. Using the new holes drilled as described above, remount R1 (on the component side of the board) between the collector of Q1 and +12V.
8. Mount Cx (on the component side of the board) with its positive lead in the hole originally connecting R1 to the base of Q2 and its negative lead in the new hole passing through the ground trace. (Refer to Figure 2.) I found 2.2 to be about right; if you want slightly "softer" keying, you can try 3.3. I do not recommend using less than 2 or more than 4 .
9. Re-check that you have performed the above steps correctly; if everything looks OK,

remount the control board.

Sorry, but you're not finished yet! The "T" signal is used to disable RIT offsets during transmit (a small VFO offset is still present, but much less than during receive). The timing for disabling the RIT during transmit is rather marginal in an unmodified 509, but it seems to work OK until the "T" signal fall time is increased. Increasing the fall time of this signal results in the RIT offset (if any) being restored before the transmitter output is reduced completely to zero. This can produce noticeable "thumps" (not really "clicks") at the very end of every transmitted "dit" and "dah" when an RIT offset is in use; not a good situation. Fortunately the problem is easily solved by using the "R" signal for RIT disabling rather than"T". The "R" signal drops to zero shortly before "T" increases above zero, and begins rising with a long time constant when "T" returns to zero.

A simple inverter, shown in Figure 3, is required in order to use the "R" signal to disable RIT offsets. I built this circuit on a small piece of "perf-board" and mounted it "spider web" style above the RIT control pot; the wire from the collector of the inverter transistor to the switch on the rear of the pot holds the board in place. The RC time constant at the base of the transistor insures that the RIT offset will remain disabled until the transmitter output is completely off. The diode across the base resistor discharges the capacitor quickly when the "R" signal drops to zero ensuring that the VFO frequency will be completely switched back from any RIT offset before the transmitter output begins rising. With the component values shown, the RIT is switched off about one millisecond before any measurable transmitter output and switched back on about one millisecond after transmitter output falls to zero.

To complete the keying modification, proceed as follows:

1. Build the circuit shown in Figure 3 on a small piece of pc-board, perf-board, or whatever you like to use for simple "once only" construction. Be sure it is small enough to fit into the space just above (or behind) the RIT control. Note that the diode must be a Ge (1N34A, etc.) or Shottky type; a standard Si diode (1N914, etc.) will NOT do the job because its forward voltage drop will be too high to provide a low resistance discharge path for the capacitor. The transistor can be just about any Si NPN switching transistor; I chose a 2N3904 because of its low collector to emitter saturation voltage (typically less than 0.2V).

2. Remove the TX-RX Mixer board; this is the small board on top of the chassis behind the VFO shield enclosure.

3. Locate the wire from the RIT on/off switch that goes under the TX-RX Mixer board. Remove the ends of this wire from the switch and the connector block under the Mixer board, but leave the wire itself in place.

4. Re-connect the end of the wire under the board to the connector block terminal to which the "R" signal is connected; this should be the second connection from the opposite end of the connector block, but check your manual.

5. Mount the inverter board above (or behind) the RIT control and connect the lead from the inverter transistor collector to the now empty RIT switch terminal.

6. Connect the end of the wire that was removed from the RIT switch to the inverter input.

7. Check your work and replace the Mixer board.

That's it; now its time to try it out! If you have an oscilloscope, use it to verify the keying waveform; otherwise, listen to the output on another receiver (being careful not to overload it). Also make sure that the RIT still works, and listen to the transmitter output while varying the RIT control (with it ON, of course!); there will be some shift in transmitterfrequency, but there should be no "thumps" or other extraneous output result-

ing from varying the RIT control.

For best CW shaping at maximum power output, increase the drive control until the power output no longer increases and then back it off just a bit. Setting the drive control "wide open" will result in key clicks and not produce any additional output power. You should also keep in mind that running much more than 5W output from "stock" finals can degrade the spectral purity of the output signal.

Now you can operate you faithful little Argonaut without fear of generating any interference from a poorly shaped CW signal!

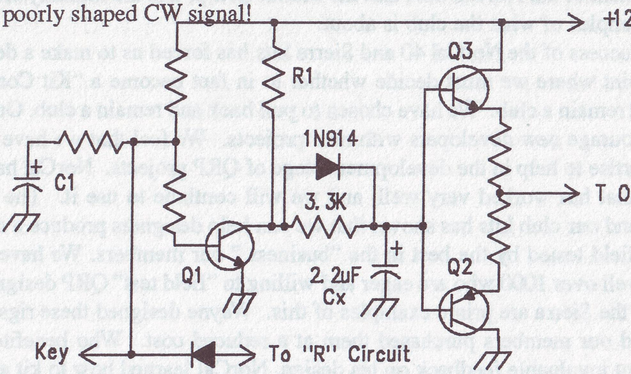


Figure 1 Modified circuit to generate transmit control signal.

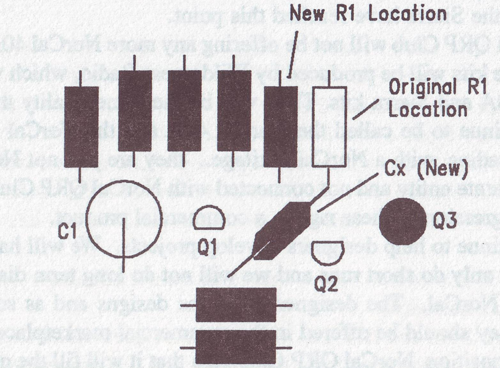


Figure 2. Parts placement on control board.

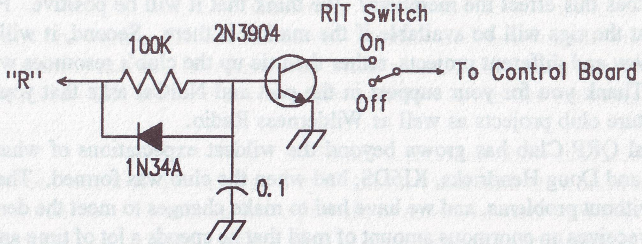


Figure 3. Inverter circuit required to use "R" signal to disable RIT during transmit.

The Future of the NorCal 40A & Sierra

by Jim Cates, WA6GER, Doug Hendricks, KI6DS, and Wayne Burdick, N6KR

The NorCal QRP Club has done two very successful kits that have set the standard for club projects. The demand for the kits continues and thus NorCal QRP Club is faced with a dilemma. Do we want to become a "Kit Company"? No, NorCal is a club, not a business. The purpose of NorCal is to promote QRP, and we feel that we do a good job. The development of the NorCal 40A and the Sierra, QRPp, and the monthly club meetings are good examples of what the club is about.

The success of the NorCal 40 and Sierra kits has forced us to make a decision. We are at the point where we must decide whether to in fact become a "Kit Company," or pull back and remain a club. We have chosen to pull back and remain a club. Our focus and job is to encourage new developers with new projects. We feel that we have the knowledge and expertise to help in the development stage of QRP projects. NorCal has a formula for success that has worked very well, and we will continue to use it. The past history of NorCal and our club kits has shown that we can help designers produce a short run of kits that get field tested by the best in the "business," our members. We have a membership base of well over 1000 who are eager and willing to "field test" QRP designs. The NorCal 40A and the Sierra are prime examples of this. Wayne designed these rigs, NorCal kitted them, and our members purchased them at a reduced cost. Who benefited? Everyone. Wayne got invaluable feedback on his design, NorCal learned how to kit and do developmental work, and our members got the opportunity to get in on the ground floor of a good project at a very reasonable cost. It was a win-win situation. But, there comes a time when these projects go past the club kit stage, and they need to become commercial kits. The NorCal 40A and the Sierra have reached this point.

That is why NorCal QRP Club will not be offering any more NorCal 40A or Sierra kits. But don't despair. The kits will be produced by Wilderness Radio, which will become the supplier of NorCal 40A and Sierra kits. They will be the same quality that NorCal provided. They will continue to be called the NorCal 40A and the NorCal Sierra, because they are still NorCal radios, with a NorCal heritage.. they are just not NorCal kits. Wilderness Radio is a separate entity and not connected with NorCal QRP Club. It is the next step in the logical progression of these rigs to a commercial product.

NorCal will continue to help designers develop projects. We will have more kits in the future, but we will only do short runs and we will not do long term distribution. That is not the purpose of NorCal. The designer owns the designs and as soon as they are commercial quality, they should be offered in the commercial marketplace.

To summarize our position, NorCal QRP Club sees that it will fill the niche of encouraging and helping our members develop QRP projects. We will help with R&D funds for worthwhile projects, and we will sell club project kits to members, but not as a long term obligation. That is not our focus, nor should it be.

How does this effect the members? We think that it will be positive. First of all, it insures that the rigs will be available if the market is there. Second, it will let the club focus on new and different projects, rather than tie up the club's resources with the same projects. Thank you for your support in the past and NorCal asks that you continue to support future club projects as well as Wilderness Radio.

NorCal QRP Club has grown beyond the wildest expectations of what Jim Cates, WA6GER and Doug Hendricks, KI6DS, had when the club was formed. The growth has not been without problems, and we have had to make changes to meet the demands of the club. Jim receives an enormous amount of mail that he spends a lot of time answering and keeping track of. He is the organizer of the club, and he keeps track of the money. When

we started, Jim also did the kits, separating and stocking literally thousands of parts in all of those NorCal 40s and Sierras. But due to the growth, Jim doesn't have time to stock kits anymore. We have found other club members to take care of that task. We want Jim writing the letters and answering the mail for all of the members. He is wonderful at his job, and we have had to get him some help with the kits, and we have done that.

QRPp is still done by me in my daughters' old bedroom on an IBM Clone and laser printer. It was easy to get them printed, folded and stapled when membership was 200. Even 500 wasn't too bad. But when the membership passed 1000, it became time to change the way that we did QRPp too. We now hire the printing, folding, stapling and preparation for mailing. To do so costs money. That is why the subscription rates went from $5 per year to $10 US, $15 (US Funds) Canada, $20 (US Funds) DX. But there is no other choice, as the number of subscriptions to QRPp has grown so large that I need help.

Is this growth bad? No, we think that it is good. We are reaching many more people with products that they are interested in. Some of our members wanted the kits, some wanted the information in QRPp, and some wanted both. Because we have such a large membership base, we are able to draw on a much larger pool of talent than the average QRP club. That has made NorCal special. That is why we have lots of exciting new articles in QRPp, why there are projects waiting in the wings to be developed and kitted. The reason that the NorCal 40A came about was that the original builders of the NorCal 40 came up with literally dozens of mods that made the rig better. That might not have happened had we been a small club of 10 or 15 members. Big is not always bad.

NorCal QRP Club has a bright future as does QRP. Thanks again for all of your help in making NorCal QRP Club what it is, and all that you have done for QRP in general. 72, Jim, Doug & Wayne

Wilderness Radio: Who, What, When?

by Wayne Burdick, N6KR

When you hear "Wilderness Radio," think Bob Dyer, KD6VIO. I met Bob the same day I met Doug and Jim, at Livermore. I was brandishing my multi-band QRP rigs when Bob walked up and said, approximately, "...so, if you ever want to start a company to sell these QRP rigs, let me know." One thousand club members and a few major projects later, it's time to take Bob up on his offer!

Bob is uniquely qualified to begin this part-time enterprise. He thrives on QRP and homebrew, is very well organized, and is about as personable and level-headed a guy as you'll ever meet. Bob has a degree in Zoology and has bird-watched in more countries than many of us have worked. Yet another hobby that requires patience! On the technical side, he has years of experience with spectroscopic equipment. This background helps explain his rapid ascent in Amateur Radio: he went from Novice to Extra in just 18 months, has worked over 110 countries QRP, has built much of his own gear, and is president of the EMARC Radio Club in Los Altos.

I would love to have started Wilderness Radio myself, but I have a great job already and just enough spare time to tinker with new radio designs. I'll be helping Bob get started, along with Dave Meacham, W6EMD, a retired EE, who has been helping me take some of the rough edges off the Sierra for the next production run. He's a whiz with filters and transformers.

You can call Bob at (415) 494-3806, or write to him at Wilderness Radio, P.O. Box 734, Los Altos, CA 94023-0734. He's currently taking orders on the NorCal 40A. The Sierra will follow in the Fall, in conjunction with my construction article in the 1996 ARRL Handbook. Check with Bob for prices or to get on his mailing list. 73, Wayne

TIDBITS by Mark Cronenwett, KA7ULD 1029 Duncan Ave. Sunnyvale, Ca 94089

Have any ideas that you would like to share with others? Well here is the place to do just that. Send your ideas to me at the address above, or by E-mail to mcron@sgi.com via the Internet.

PROTECTING RUBOFF LETTERS

From: Paul NA5N

Rob WA3ULH discussed using clear fingernail polish to protect rub-off letters from ... well, rubbing off. DATAK (who makes rub-off letters for electronics) also has a clear protective goop with brush. Frankly, the clear fingernail polish is about the same and probably much cheaper.

Another alternative is to use KRYLON No. 1306 WORKABLE FIXATIF spray coating. It is available at art and office supplies (vice a hardware store). A can will last for years. You spray it on just like paint. It goes on as a shiny coat. I usually put on a rather light first coat to just bond the letters, then a heavier 2nd and/or 3rd coat. If you put a real heavy 1st coat, the letters can dissolve! With a light 1st coat, let it dry, then dump it on, works very well. Its nice in that it puts an even protective coat over the entire panel surface. Each coat dries in a few minutes (no overnight thing).

The Fixatif is meant for protecting pencil sketches. I have used it on pencil drawn schematics of ham projects ... put on a light single coat, and the pencil won't smear and its quasi-water proof. It also works GREAT for weak photocopies. If you make a photocopy of a data sheet or schematic (or preparing camera ready art), the Fixatif slightly dissolves the graphite on the photocopy, blending it together for an impressive look. Also, the graphite won't thereafter flake-off. On a previous suggestion of doing the front panel lettering on a PC and photocopying onto a clear plastic carrier, I have used the Fixatif to bond the graphite to these plastic sheets. There is also a drafting film available with a self adhesive back which can be removed after photocopying. Its kinda a foggy white. The Krylon, if applied a little heavy, seems to convert the foggy matte look into more clear and transparent. The backing can be removed to expose the adhesive and applied (stuck) to the panel directly. The Krylon coating will help keep the letters from flaking off.

Paul NA5N

SOLDER FLUX FUN!!

From: Dennis, K1YPP

Just wanted to make a few quick comments on the solder/flux dialog: The old rosin core solder can tend to leave some ugly looking brown material on the joints, but from an operational perspective, it is reasonably insulated and at DC and low frequencies it doesn't do a lot of harm. It is wise to clean off as much as possible, but the effort may have diminishing returns. It is especially difficult to remove if it is very old.

The water soluable stuff is very easy to clean. A mild handsoap and warm water works very nicely, the soap isn't even necessary. Contrary to the rosin solder however, it really should be cleaned if high frequencies or extremely small currents are involved. If this stuff is used with CMOS circuits, or devices such as the Unitrode UC3906 battery charger chip, strange things can occur if it is not cleaned off. A CMOS chip, such as the Curtis Keyer 8044ABM will start to key itself, or not key at all etc. The UC3906 previously mentioned has currents as small as 10 microamps, and this flux, if left on, can offer paths as low as a megohm between pins on the IC. Things can vary with temperature and humidity and drive a builder crazy if they are not aware of this flux being on the board. I prefer the water soluable stuff, it is more pleasant to work with, but must be cleaned off.

72, Denis

NorCal 40a Variable Bandwidth Xtal Filter Mod.

by Monte "Ron" Stark, KU7Y
285 W. 4th Ave Sun Valley, NV 89433
ku7y@sage.dri.edu

The NorCal 40a is a very nice radio. One of the things I like about it is that you can do so much with it. I have added an AF volume control (which Wayne keeps saying I don't need!), and a keyer. The keyer is based on the Curtis 8044ABC chip. So far, so good.

Good radio and I could have left it just like it was. But what the heck, why not look for things to keep making it better?

Wayne Burdick E-Mailed this idea to me awhile back and yesterday I got around to trying it. What is it? How about making the crystal filter a variable bandwidth filter? Take four resistors, three diodes, one capacitor and mix with a little solder, wire and a few minutes of your time and presto, you have a nice working variable bandwidth filter in your 40A. I haven't measured the response of the modified filter but judging by the seat of my pants I would say it goes from over 1 Khz to about 100 Hz. In the wide position you can hear both sides of a signal. In the narrow position all you hear is the station you are listing to. Wayne is using a similar system in his Sierra with good luck.

Parts needed: 3 - MVAM108 Varactor diodes. (I got mine from Newark Electronics), 3 - 100K 1/8W Resistors, 1- 10K Linear Taper Pot, 1 - 0.1 uF Capacitor

Now comes the fun part. You will need to drill a hole in either the front or rear panel. I chose the front because there isn't any more room on the back on of mine.

1. First remove C10, C11 and C12. These will not be reused. Use care in doing the removal. This is a high quality board but with enough abuse it could be damaged! If you have a hard time getting things off boards, cut the leads and then remove the lead. Clean the holes with a solder sucker and or solder wick.

2. Install one end of each of the three 100K resistors where the removed capacitors connected to the crystals. Connect the free end of these restores to the wiper of the 10K pot.

3. Connect one end of the 10K pot to ground. I used a piece of wire from the pot to the ground hole of C12.

4. Connect the 0.1 uF capacitor between the wiper and the ground end of the 10K pot.

5. Connect the other end of the 10K pot to the regulated 8vdc. I connected a wire from the pot to R20. Use the end of R20 that is facing away from the front panel. DO NOT connect to the R17 side.

6. I chose to mount the diodes on the bottom. Mount them where the original capacitors were located. Connect the cathode to the crystals and the anode to ground. Use the picture in the 40A manual to orient the diodes correctly.

Do the normal checking for solder bridges etc. Then fire it up. I took the time to realign the whole rig. Then I started playing with it. Wow, what a rig. I leave the filter wide while tuning and calling cq. Then, while in qso, I narrow it down until it seems right! The more qrm the narrower I go!

Enjoy the rig and give the thanks to Wayne, both for the rig and the mod. Atta boy, Wayne!

72's, Ron, KU7Y

P.S. There are 2 filters in the Sierra. To make it wide enough to listen to ssb you need to add one of the diodes to the second filter also. Wayne has all the details. Just e-mail him for the info.

The NorCal QRP to the Field: Mt. Baldy Expedition

by Paul Harden, NA5N (pharden@nrao.edu)
120 Garden Circle
Socorro, New Mexico 87801

Five hams from Socorro, New Mexico, decided to scale Mt. Baldy Peak to operate the contest from the nearly 11,000 foot summit. Calling the Forest Service, we found out no one had yet made it the top this year and the status of the road was unknown. About 8:00 am, armed with two 4-wheel drives, QRP rigs and foul weather gear, off we went. All was fine until about 9,500 feet when we entered "Sherwood Forest," about a half-mile stretch of road through tall pines that never sees the sun! The hard icy snow covered road and the snow drifts offered the road virtually impassible. But after considerable time getting stuck, digging paths with shovels and simply ramming the snow drifts with our 4WD's, we finally made it through Sherwood Forest. Oddly, there was little snow at the summit. We called the Forest Service monday morning and informed them "the road to Mt. Baldy is NOW open" We figured they owed us big bucks for this service!

The participants were:

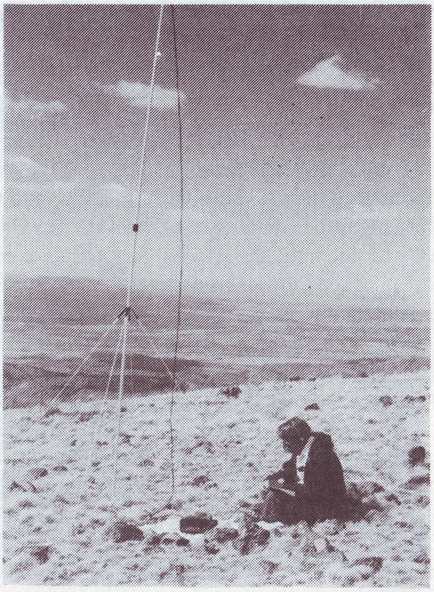
- Paul Harden, NA5N
- Doug West, AB5WT
- Dave Finley, N1IRZ
- Chuck Broadwell, W5UXH
- Howard Peavy, K9PV

Doug AB5WT digs out his Jeep while Paul NA5N works on the next snow drift with his Land Cruiser.

Near the summit there is an old comet observatory building, where we setup. Doug AB5WT and Dave N1IRZ setup their stations near the northeast corner of this building to shroud themselves from the cold, bitter wind. N1IRZ worked 20M CW and hung his dipole between a weather station mast and the end of a 60-foot boom crane parked nearby in an E-W direction If only we could have raised that boom! (We checked; no batteries installed). Doug stretched his 40M dipole from the same weather station mast to a bracket on the observatory dome, running N-S to be opposite Dave's antenna. This arrangement seemed to cause little interference between the two stations. N1IRZ made the first "to the field" contest QSO a bit after 12:00 noon and AB5WT shortly thereafter ... a mere 4 hours after leaving Socorro. (The summit is about 25 miles from Socorro). N1IRZ used his QRP+ while AB5WT was true to the cause by using his NorCal 40.

Paul NA5N setup along a ridge south of the observatory building, stretching his 40M dipole between his Land Cruiser and a self-supporting 16-foot mast taken along for the occassion. About 100 feet away was a large cable roll, which Paul felt would make a better "desk" than the small table he had taken. It took over a half an hour, but Paul finally rolled the cable roll, and unrolling the cable wire still attached, to underneath the center feed of the dipole. It made an authentic "to the field" operating fixture for his station, as shown on the photo page. The resulting splinters combined with cold fingers made for some interesting CW keying. Paul used his "mini-rack" of homebrew and heavily modified MFJ gear on 40M CW.

To his credit, Chuck W5UXH was the only one to operate from the actual summit. He backpacked his NN1G and other earthly belongings (like lunch) and hiked to the summit. Chuck put up a 40M inverted vee from a 16-foot telescoping mast he hand carried and QSO'd a few stations. However, after fighting the elements, he retreated about 2pm and setup his station again several hundred yards west of the observatory building and operated some more.

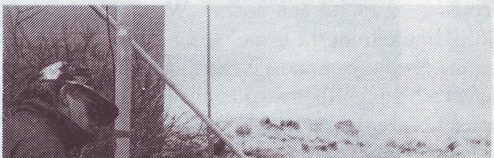


Chuck W5UXH operating from the summit. The view was spectacular. We think the haze on the horizon is the Pacific Ocean.

Howard Peavy K9PV had to leave town after us and decided not to tackle "Sherwood Forest" by himself (a wise decision). He operated his station from a campground inside a canyon amidst tall pines with fair success. He strung a 40M dipole between two pines up about 30 feet using the fishing-line-and-rock-technique. Howard operated his NorCal 40 in the prone position on a sleeping bag ... an operating posture Howard said he'll not do again. Howard camped the night here.

It was still wintertime above timberline in New Mexico: the wind blew the entire time, the weather was cold (41 degrees at 3pm) and it finally beat us about 4pm when we tore down the stations and retreated to warmer ground. Inspite of our harsh environment, the contest was fun. To demonstrate how the weather worked on us, notice the photo on the next page of AB5WT stringing his antenna, wearing only a shirt and no hat. The photo below is an hour later; Doug has by now donned a heavy coat and ball cap. Another photo on the next page was taken about 3pm; Doug has reverted to full foul weather gear. All of our "dress codes" seemed to change in a similar manner.

We found no tactical advantage from our mountain top location, at least using dipoles. Verticals, offering a lower radiation angle, would probably be more effective.



Doug AB5WT working his NorCal 40 with Dave N1IRZ's QRP+ 20M station on the right.

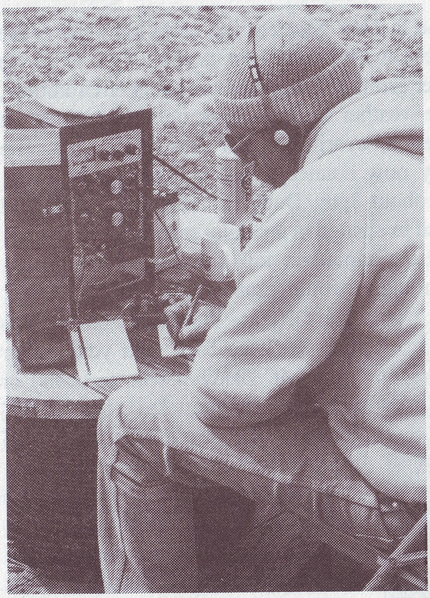
The QRP "to the field" exercise was fun. We'll be back next year, either from Mt. Baldy (with verticals) or another unique "to the field" location. A date a little later in April might offer better seasonal weather.

The excellent photos in this article were all taken by Dave, N1IRZ. Somehow in the all the excitement, we unfortunately never got a photo of him or of Howard K9PV. But with no photos of them, it makes is easy to just say "they were the handsome ones in the group!"

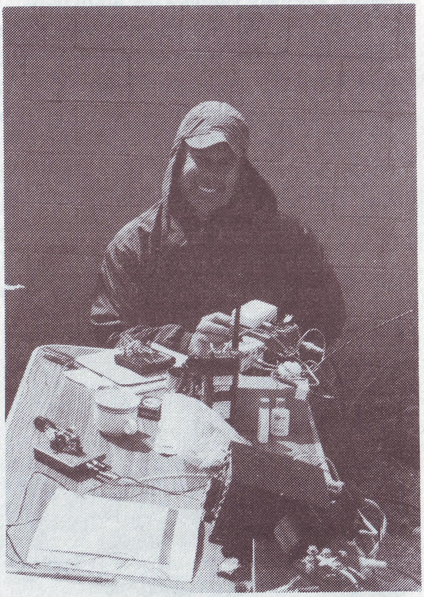
-- 72 de your friends in New Mexico

Doug AB5WT raising his dipole from the weather station mast. The wind speed instrument was missing two blades!

NA5N's station and dipole "up 10,700 ft." The actual summit is in the rear where W5UXH setup his first station.



NA5N working 40M CW with his "mini-rack" QRP station, powered from the cup of hot coffee and corn nuts.



Doug and the AB5WT/N1IRZ station, by now well bundled up. He's not smiling; he just froze up stiff that way.

All photos courtesy Dave Finley, N1IRZ

What's your story? Send your story and photos to QRPp editor Doug Hendricks, KI6DS

Back Issues of QRPp

Back issues of QRPp are available in bound issues only. Volume I contains the 3 issues from 1993, and Volume II contains the 4 issues form 1994. Volume I is 140 pages and costs $10, while Volume II is 296 pages and costs $15. Both years are $25. To order, send your money to: Doug Hendricks, KI6DS, 862 Frank Ave., Dos Palos, CA 93620. Make all checks and money orders out to Doug Hendricks, and NOT to NorCal! DX orders please include $10 extra per order for postage. All prices are for US Funds only!

Curtis 8044ABMKeyer Chip and Far Circuits Board Combo

NorCal has made a bulk purchase of the Curtis 8044ABM Keyer Chip and is offering it with the Far Circuits Board and the Info Sheet for $17.00 Postpaid. DX orders add $5 shipping. US Funds ONLY!! Make Checks or Money Orders out to Jim Cates, NOT NorCal! Send your orders to: Jim Cates, WA6GER, 3241 Eastwood Rd., Sacramento, CA 95821.

NorCal QRP Club

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